THE STATE OF PRACTICAL WORK IMPLEMENTATION IN BIOLOGY IN SOME UPPER PRIMARY SCHOOLS OF SELECTED WOREDAS IN BENCH – MAJI ZONE.

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The State of Practical Work Implementation in Biology in Some Upper Primary School of Selected Woredas in Bench- Maji Zone.

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Definition of Acronyms

PW: - Practical Work

MOE: - Ministry of Education

SNNPR: - South Nation Nationalities and peoples Region

REB: - Region Education Bureau

ZEO: - Zone Education Office.

ABSTRACT

Practical work method considered to be an essentials ways of teaching science and educators have suggested the many benefits accrue from engaging students in science practical activities, even though a number of factors influences its effective implementation. The purpose of this study was to determine the state of practical work implementation and factors impeding the activity in teaching biology in this line it focuses on the, significance of practical works, magnitude of use, types of practical activities and factors hindering its implementation.

The study was conducted in eight selected upper primary schools in three woredas and one town administration Bench – Maji Zone of SNNPR. In order to carry out this study the researcher has employed the descriptive survey method. For the study the woredas with relatively accessible were identified using purposive sampling techniques. Data were collected from the schools which were selected by non-random proportional stratified sampling procedure according to the number of upper primary schools in each woreda. Accordingly,139 seventh grade and 128 eighth grade students were also selected using the same procedure and systematic technique for representatives. A total of 31 teachers were taken purposefully. In regarding the data from the respondents, questionnaires consisting of 14 and 24 items for students and teachers respectively were used. To validate the data, interview questions of 9 and 50 items respectively were used in to three selected schools.

The data collected were analyzed and interpreted in series of table using percentage scores. Accordingly, the majority of respondents have confirmed that, practical work method is rarely employed or put into practice.

In this study, the current state of practical work in eight upper primary schools was found to be very poor and in the spiral of traditional approaches that have greater emphases on recall of knowledge and understanding of contents. Based on the finding, suggestions for the possible solution are recommended.

Chapter – One

1. INTRODUCTION

1.1.BACKGROUND OF THE STUDY

Practical work method in school teachings, since its origin, has gradually acquired an increasing and influential place in school science teaching. Several researchers in the field and science teachers believed and recognized the importance of practical work in science education. They have placed great emphasis on teaching of laboratory work arguing that students should have first-hand experience in order to acquire skills in handling apparatus, to measure and illustrate concepts and principles (Layton, 1990; Friendlier and Tamir, 1990; Woolnough, 1991; 1994; Parkinson, 1994; Martin et al., 2001). Others, similarly show that, since 1960s ,science curricula have emphasised the inquiry approach by claiming that 'doing science' like real scientists is the most promising method by which students will master inquiry skills and became literate in science and thus literate citizens of the today's society.(Lazarowitz and Lazarowitz,1998; Yager, 1991; Hegarty,1990; Klopfer,1990).

The practical work method implemented so far went through many reform efforts because science teaching of the then years has failed to reflect the desired change in science (Schwab, 1964; and Gleen, 1965). After 1960s, the practical work method was considered as the most appropriate appoach for achieving the goals of science education (BSCS, 1971; Nuffield Biology project (1966) cited in Mekuanent, 1992; Romey, 1968). Significant trends have been continued with an increased emphasis on students' involvement in scientific investigation through laboratory work and field study. This is based on the belief that science can not be effectively learnt without experiencing it.

The new conception of the role of the school laboratory work has resulted in curriculum shift from science as a useful knowledge to science as an activity. Thus the impetus for doing practical work continued with the pressure grew strongly in the second half of nineteenth century both in the UK and USA that led to the change advocated by the curriculum reform movement (Lunetta,1998; Layton,1990; Woolnough and Allsop,1985;).

Educators claim practical work teaching and provided a number of reasons for carrying out practical activities in science teaching. The prime assumption is that, learning in general and

science in particular is more effective if the pupils are actively involved in obtaining information(Romey, 1968; Matiru, et al, 1995; Martin, et al, 2001; Temechegn, 2001;2002; Akalewold, 2001; 2003; Brown, 1995).With no doubt about it, practical work is an essential part of a scientist's way of operating and it would be a very peculiar science education (Parkinson, 1994; Lunetta, 1998; Arzi, 1998; Woolnough, 1991).

On the other hand, though the importance of practical work continued to be essential, the evaluation of its effectiveness in the process of science learning suggested that the returns of its investment (time, resource and energy) are not promising. For example Klanin(1988) in Akalewold (2001) pointed out, the problem of implementation and lack of incentives as reasons that affect its effectiveness.

In recent years, research evidences show that practical work indeed makes significant educational contribution. Although, the controversy concerning the role and the relative emphasis of laboratory activities have not been resolved, the importance of practical work was increasing in recent years (Lunetta, 1998; Layton, 1990; Matiru et. al.,1995)

In the context of Ethiopian, the policy document emphasising the importance of science education states to that the teaching and learning of science should enables students to understand scientific concepts and thereby inter-dependability develop rational thinking, solve their daily life problems and develop scientific skills to achieve scientific judgements (MOE, 2002). As a result, teaching and learning of science in the upper primary schools (grades 7and 8), which was given as an integrated form in the past, was decided to be given as physics, chemistry and biology subjects as a separate disciplines. For this, it reasoned out that giving special due concern to natural science subjects and mathematics will enable students to understand nature, enrich their scientific out look and employ scientific knowledge to solve environmental and societal problems (MOE, 2002:25).

As it is stated above, the biological science curriculum was designed in a way it incorporates practical activities as one of the major essential tasks in teaching biology. Accordingly, biology teaching materials for grade 7 and 8 incorporated different models of practical work teaching strategies such as projects, practical activities, field visits and observation to help meet the objectives.

In bringing the issue of practical work in the context of biology, Glenn, (1995); Brown,(1995); Dallas, (1980); Majasan, (1995) note that the approach to science and what suggested for science is equally true in any field in which making and doing make teaching and learning effective. Thus, biology as a component of a natural science, its teaching methodology owns many characteristics that it shares with other fields of natural science.

More clearly, Woolnough and Allsop, (1985) suggest that practical laboratory work should involve exercises, by which practical skills and techniques are developed, investigations, based on problem-solving activities and, experiences, by which pupils get a feel for phenomena be strengthened .Thus, all what has been mentioned so far are true for biology despite it carries unique possibilities and demands because of the subject mater with which it is concerned.

As back as 1965, Gleen notes that practical work in teaching biology must be a challenge to create thought, and not just a process of looking, drawing and doing. Because it is a problem-solving task, it must be undertaken to solve a problem. Dallas, (1980); Brown, (1995); Majasan, (1995) much more convincingly suggest that biological science must have a strong practical bias as practical work is a pillar of teaching biology.

Even though, it is regarded as important teaching method, many researchers and educators in the area note that, due to several factors the practical work is not fully implemented in teaching biology. Gleen, (1965) reported that biology tends to be learned too much from books and blackboard, and too little from specimen (especially from living once), field work rare to be cursory and merely observational, lacking analytical recording and experimentation. Similarly, other literatures also show that teacher's motivation and capability willingness to use the materials, lack of laboratory and laboratory equipments, time and attitude towards the method can affect practical implementation (Miller, and Blaydes, 1962; Mekuanent, 1992; Brown, 1995; Akalewold, 2001; 2003; Temechegn, 2001; 2002; Allsop, 1994; Lunetta, 1998; Gleen, 1965).

The theme of this study is to assess the extent to which practical work is implemented in teaching biology and to find out factors affecting the implementation of practical laboratory method in teaching biology in primary second cycle Schools (grade 7 and 8) in SNNPR Bench-Maji zone.

1.2.Statement of the Problem

Science has a unique value as a means of education. It provides the opportunity to acquire knowledge through experiment, observation and problem-solving (Kerr, 1963). Science laboratory works are indispensable to good science teaching because they provide first-hand experiences in observation, experimentation and manipulation of scientific materials (Matiru, et al., 1995; Brown, 1995; Woolnough, 1985; 1994; Hegarty, 1990; Akalewold, 2003). Today, practical work has a prominent position in science education, based on the assumption that learning by doing is best way for acquiring technical skills and science cannot be effectively learnt without practicing it (UNESCO, 1969; 1979; Woolnough and Allsop 1985; 1994; Martin et al, 2001).

Researches on science education in recent decades inform us more appropriate use of the school practical work to promote important science learning outcomes. Practical activities have the distinct advantage of enabling students to work directly with materials and phenomena in the students' biological and physical environments. It creates a special atmosphere that suggests activities and affects student's perception of science (Lunetta, 1998; Arzi, 1998; Klopfer, 1990; Layton, 1990).Layton, (1990) more stressed that science education without practical experience is unthinkable. In support of this (White, 1988 quoted by Arzi, 1998) presents that:

The laboratory sets science apart from most school subjects. It gives cience teaching a special character...Without the laboratory works it could be difficult for students to comprehend what scientists do (Arzi, 1998:598).

The use of practical work in science education is relatively recent-in the mid-nineteenth century. According to Kerr, (1963); Matiru et al. (1995); Lazariowiz and Tamir, (1994); Akalewold, (2003) towards the end of the nineteenth century the promise more enlightened approach to science teaching arose through the works of researchers in the field. Practical work has undergone various reformations from the late 1950s, and during the later 1970s, developed to a trend towards a various approach to learning in school laboratories. This was a move away from teacher-paced learning towards a more learner-oriented approach.

The role of practical work in science learning has been much debated, discussing issues such as motivation, skills development and learning about scientific methods. (Hodson,1993 and

Atkinson,1990). Atkinson, more recognized that educators such as Kruglok, (1952); Uricheck (1972) Osborne and Frey berg (1985) have quered whether the intended learning outcomes are actually achieved through science laboratory.

Though there is different contention among the educators in the field, there is also many other positions in support of practical work approaches in teaching science education (Hegarty 1990; Woolnough 1985; 1994; Martin et al 2001; Gott and Duggan (1995) in Akalewold, 2003); Akalewold, (2001; 2003).

Putting this in context of practical work method in biology, teaching biology topics involves considering of the same fundamental issues as in teaching science. Dallas, (1980); Majasan, (1995) note that biology is a science and that science is based on investigation. So, the right approach to gaining biological knowledge must be through investigation and practical experiences.

On the other hand, many researchers show that several factors affect the implementation of practical activities in teaching biology. As a result the attainments of the stated objectives in the subject remain unsatisfactory. Lack of laboratory work and equipments the nature and aim of practical activities in the curriculum, the demand for huge quantities of resource, and large class size (Miller, 1962; Akalewold, 2001), shortage of time, lack of insufficient resources and facilities, teachers methodology of teaching, interest and attitudes of both teachers and students towards the practical activitiy (Miller, 1962; Kerr, 1963; Gleen 1954; 1965; Martin et al, 2001) teachers motivation (Abera, 2004)are some factors to be mentioned.

Although these factors might be common to many primary schools of the country, it might be more serious in the school at the remote areas.

One of the aim of education is strengthen the individuals and societies problem-solving capacity and good ability at all levels. Accordingly, the new education and training policy of Ethiopia (MOE, 1994:4) emphasis the development of problem-solving capacity and culture in the content of education, curriculum structure and approach, focusing on acquisition of scientific knowledge to be used in solving societal problems.

Accordingly, the biology student text for grade seven and eight teaching materials aim to encourage students to explore their surrounding and take active participation in solving social problems existing in their respective environment, by making them actively participate in

different activities such as projects, practical works and field observation programs (SNNPREB, 2004).

It is also clear that the policy document admits the existing shortage of basic educational inputs like qualified teachers, laboratory and equipments and other facilities for quality education and also promises for its fulfilment. And to alleviate the problems of education, the Ethiopian government has exerted an on-going effort to make available adequate inputs for quality improvement of education (MOE, 1994; MOE, 2002). Yet, the government is still confronted with challenge of providing quality education.

Research findings show that, teaching and learning in Ethiopian context is highly affected by the curriculum materials provide, relevance, the extent to which subject teachers try to implement according to its objectives and different educational inputs.

Teaching and learning in Ethiopian context is highly affected by the curriculum materials provides, relevance the extent to which subject teachers try to implement according to its objectives and different basic educational inputs (UNESCO, 2002; Abera, 2004; Temechegn, 2001; 2002; Mekuanent, 1992; Akalewold, 2001).

As it is mentioned above, the Minstry of Education incorporated the practical activities as one of the major and essential tasks in teaching biology. Accordingly, biology teaching materials for grade seven and eight incorporated different models of practical work teaching strategies.

Therefore, from the above description on the issue, one can not realize to have those advantages of school practical science unless the practical works are properly implemented. Hence, the extent to which practical work is implementing in teaching biology and the inhibiting factors need through investigation.

1.3. Objectives of the Study

1.3.1 General Objective

The major purpose of the study was to assess the extent to which the PRACTICAL WORK is implementing in teaching biology and to identify these influencing factors in upper primary school of Bench Maji Zone.

1.3.2 Specific Objectives

The study aims to:

- ❖ Explore the status of practical work implementation in teaching biology with particular emphasis on primary secondary cycle schools of some selected woredas of Bench-maji zone.
- ❖ Examine the degree to which biology teachers and students implement practical activities in teaching- learning biology.
- ❖ Explore teacher's and student's attitudes towards practical work in teaching-learning biology in the schools under study.
- ❖ Investigate the extent to which students of the target schools implement practical work method in learning biology.
- ❖ Explore reasons for the happening of ineffective practical work method in teaching biology.

With these objectives this study will find answers for the following basic research questions.

1. How often do biology teachers in primary schools use practical work methods in teaching biology?
2. What are the attitudes of biology teachers and students towards practical work activities in biology?
3. What factors do affect teachers' use of practical work method in teaching biology?

1.4 *Significance of the study*

Teaching in science should receive special attention in developing countries like Ethiopia which the fruits of modern science and technology have to be utilized for the progress and prosperity of the nation.

Almost all research and educators in science education agree that, the right approach to gaining biological knowledge must be through investigation which comprises experimentation, examination, observation, field work and other discovery teaching techniques as a central in teaching the subject (Majasan, 1995; Romey, 1968; BSCS, 1987; Woolnough, 1994; Brown, 1995).

It would be logical to assess the extent and challenges in implementing practical works in teaching primary school biology. Therefore, the study is felt to be important for the reason that

the biology teacher, lab assistants, school administrators and other concerned bodies recognize the problems encountered in teaching biology So that, they could set relevant strategies to solve the problems.

It will also help supervisors and biology teachers for the future assessment in the area. The assessment result would therefore help science teacher and science educators at institutions, education offices of Bench-Maji Zone and SNNPREB also benefit in having the current situation of the practical activities in relation to the suggested practical works in the teaching materials.

Hence, they can find solutions and various ways to alleviate the conditions and help implementation of the practical activities and evoke students have the required practical skills through exercising the activities and use their skills in solving various problems in their daily life.

1.5 Delimitation of the study

The purpose of this study was to investigate the extent to which practical teaching methods is implemented in teaching biology in primary second cycle schools in Bench-maji zone of SNNPR. The study concentrates on the primary second cycle schools in some selected woredas of the zone with particular emphasis to grades seven and eight primary schools in four woredas namely, Temenja Yazhe, Genja, Bebeka, Mizan number one, Biftu, Gaizika, and Sheko primary schools.

1.6 Limitation of the Study

The research would have been more reliable and if all upper primary schools in the zone were included. So this was the major limitation of the study.

1.7 Definition of Terms

1.7.1 Definition of important concepts

Practical work is as defined by Tamir and Lazarowitz (1994); Hegarty (1990), Lunetta(1998); Akalewold, (2001; 2003) in science means the doing of experiment, practical activities, observation exercises with scientific apparatus in or out of the classroom. The practical works as terminology in the UK corresponds to the terminology laboratory experiments used in

the U.S.A literature. Similarly for this study, the term practical work means an activities especially designed in the students' teaching materials, where students are required to interact or engage in group or individually, and in or out of the classes in some way form though experimentation, observation, demonstration, and field trips by the purposeful plan and guide of the teacher.

Chapter Two

2. Review of Related Literature

This chapter presents review of the most relevant literature and research findings related to the problem under study. In the first part the definition, perspectives, purpose of practical work in science education and methods/types of practical work teaching will be discussed.

The second part deals with the special nature of science education including biology, the need and importance of biology, basic approaches to its teaching. The third parts discuses the factors impeding the practical activities in teaching biology. Finally the development of science education in relation to modern education in Ethiopia and the current situation to policy context is overviewed.

2.1. Definition and Perspectives of Practical work

Practical work has long been a distinctive and central role in science curriculum, and science educators have suggested the many benefits accrue from engaging students in science laboratory activities. Practical work has also long been an area of contention (Lunetta, 1998:249; Woolngough and Allsop, 1985; Woolnough, 1991; 1994).

A term PW for the United Kingdom (UK) and literatures of its previously affiliated countries corresponds to the term laboratory work used in U.S.A. literature. (Lazarowitz and Tamir 1994; Akalewold, 2001; 2003). Lunetta (1998) also showed that *laboratory experiments* as terminology in the U.S.A corresponds to the terminology *practical activities* used in the UK literature. These terms have embraced an array of activities but normally they refer to experiments in school setting in which students interact with materials to observe and understand the natural world.

Similarly, as to Hegarty, student laboratory work is a form of PW taking place in a purposely assigned environment where student engage in planned learning experiences, and interact with the materials to observe and understand phenomena (Hegarty, 1990:4; Akalewold, 2003:69-70). Woolnough also added that, though it is not easy to define the term PW in science is defined as the doing of experiment, or practical exercises with scientific apparatus, usually in a science laboratory (Woolnough, 1991). Further more, Lazarowitz and Tamir (1994) agree that

the distinctive role and unique potential of laboratory work and the difficulty in obtaining confining data in its effectiveness of learning in the laboratory. It was observed that educators still faced the problem of defining laboratory activities as an essential of the science curriculum due to the complexity of factors related to the PW and the use of assessment procedures that have often been inadequate.

Historically, practical work has established a large and influential place in the science teaching. But so of its existence its nature and practice have changed considerably, especially over the last three decades (Layton, 1987) in Woolnough, (1991); Layton, 1990; Lunetta, 1998). Since 1950s, schools in the UK and U.S.A have moved from the standard "Cook book" exercises to verify theory, through the 'guiding discovery' of the Physical Science Study Committee (PSSC), Biological Science Curriculum Study (BSCS) and Nuffield Courses, initiatives (Ibid).

Hodson argues that PW need not always comprise activities at the laboratory bench. It is any learning method that requires being active rather than passive, accords with the belief that students learn best by direct experience (Hodson, 1990). Akalewold (2001) recognized practical work as activities especially designed in the students' textbooks, w here students are required to interact in some way form thorough observation (in demonstration) to employ some problem-solving skill in doing science (in case of doing simple experiments).

For this study, as it is defined by scholars above, the term PW is assumed that student engage in group or individually, and in or out of the classes' observation and field trips by the purposeful plan and guide of the teacher.

2.1.1. Rationales for Practical Work in Science Education

Practical work learning has gradually acquired an increasingly prominent place in the school science curriculum, reaching its peak in the curriculum reform of the late 1950s (Friedler and Tamir, 1990).

According to (Edgeworth and Edgeworth (1811), Rosen (1954) in Lunetta (1998) and Arzi (1998), from early in the 19th century, laboratory activities were reported to assist students in making observations about the natural world. They also note that laboratory activities long

have had a distinctive and central role in the science curriculum, and science educators have suggested that many benefits accrue from engaging students in science practical activities.

Arzi,[1998] furthermore, sharing the educational potential of laboratory work in his works entitled, E*nhancing Science Education Through Laboratory* E*nvironments*: *More than Walls, Benches and Widgets'* assumes that... laboratory work is both a means and an end in science education and that some of school science teaching should be carried out in a flexibly designed laboratory. Friedler and Tamir (1990), state that the new conception of the role of the school laboratory was one of the major changes advocated by the curriculum reform movement in the U.K and the U.S.A and elsewhere, i.e. it was not to be a mere illustrative confirmative adjunct to the learning of science, but, instead was to become the centre of the instructional process.

In the 1960s, both in the USA and U.K major science curriculum projects (BSCS, PSSC, and CHEM study in the U.S.A and the Nuffiled programs in the UK) aimed to engage students in investigation and inquiry as a central part of the study of science. Since then the laboratory experiment continue to have a prominent place in the rhetoric of science educators today (Lunetta 1998, Friedler & Tamir, 1990).

Woolnough (1991), point outs that, pupils learning to do science as scientists do is the most appropriate models for school science. Thus, it is generally accepted that practical work teaching will be at the heart of science education. Here. Layton (1990) underlies that:

> *"Science education without some laboratory experience is unthinkable; but, equally, student laboratory practice is not a general panacea, the universal means to a multiplicity of ends".*

A number of writers in the field offered many reason as a rationale for student practical work. For example, Matiru et al., (1995) summarized the current goals of practical work to be four major statements (1) teaching technical skills relevant to the subject (2) understanding principles and the process of scientific enquiry (3) developing systematic problem-solving skills (4) nurturing the development of professional studies, practices and commitment. Lazarowitz and Tamir (1994) summarized seven rationales from Shuluman and Tamir (1973) and Friedler and Tamir (1990). Tamir (1991) from the works of Bruner, Gagne, Schwab, Piaget, Ausubel and

Karplus synthesized five major reasons as rationale for the school science practical work. Brown (1995) Akalewold (2001) also claims these five major rationales.

These five major reasons include:

1. Science involves highly complex and obstruct subject matter. Many students fail to comprehend such concepts without the concrete props and opportunities for manipulation afforded in the laboratory.
2. Students' participation in actual investigations developing their enquiry and intellectual skills in an essential component of learning science as enquiry (Schwab, 1960; 1962). It gives students an opportunity to appreciate the sprit of science and it promotes problem-solving, analytic and generalizing ability (Ausubel, 1968). It develops important attitudes such as honesty, readiness to admit failure and critical assessment of result and of limitations, better known as scientific attitudes.
3. Practical experiences, whether manipulative or intellectual are qualitatively different from other experiences and are essential for the development of skills and strategies with a wide range of generalizeble effects (Gagne, 1970; Tamir, 1972; Oslon 1973).
4. The laboratory has been found to offer unique contexts conducive to the identification, diagnosis and remediation of the students' misconceptions.
5. Students usually enjoy activities and practical work and when offered a chance to experience meaningful and non trivial experiences they become motivated and interested in science.

Though, many of these rationales are also pertinent to non-practical teaching as well, the instructional potential of laboratory is enormous. For some of the goals, the laboratory is essentially the only available setting in schools (Lazarowitz and Tamir, 1994; Woolnough, 1994; Akalewold, 2001). Ausubel (1968) in Akalewold notes that:

> *...the laboratory typically carries the burden of conveying the method and sprit of science, where as the textbook and teachers assume the burden of transmitting subject matter content.*

Henry in Gardner and Gauld (1990) documented claims that laboratory work led to many different desirable outcomes in cognitive, psychomotor, and effective domains. He also synthesized from Bruner (1960); McDonel (1959) and Kerr (1964) such out comes included better understanding, familiarity with techniques and apparatus and manipulative skills

respectively. Similariy, Tamir (1991) emphasized that laboratory is expected to provide for the development of motor and intellectual skills as well as problem-solving abilities and effective outcomes since the major learning mode is direct experience. Here in support of this Olson (1973) in Akalewold (2001) also depicted that schools serve poorly the development of skills, because learning skills require 'direct experience'.

Millar (1991) also indicates that it is hard to imagine school science without strong practical emphasis. The characteristic of school science which most clearly differentiates it from other subject in the curriculum is that science lessons take place in laboratories, where pupils and teachers carryout practical investigations and demonstrations.

Parsons and Matson 1998 in their work titled *"Achieving Scientific Literacy by Doing Science'* advocated as inquiry teaching as central element in science teaching... by stating that it *does not suffice to simply teach facts and have students perform 'cook book' laboratory experiments and ability to do scientific enquiry is one of the vehicles for achieving the purpose of since education...* (Parson and Matson, 1998). Lunetta, (1998) also notes that, the laboratory offers practical experiences that, when properly developed, can enhance students' conceptual understanding and their understandings of the development of validation of scientific knowledge. Therefore, from the above discussion it is possible to realize that practical work is the basic significance and important to fulfill objectives of school science. As a result, the method is claimed to be very essential way of teaching science.

2.1.2. The Purpose of Practical Work in Science Education

PW has gradually acquired an increasing prominent place in science education. Literatures show that, science teaching is essentially a practical activity, with a long tradition of pupil experimental work in schools. Woolnough from the research findings developed the purpose of doing practical work as follows.

> *Doing practical work provides a re-affirmation of the vital importance of practical activities in science, centered on problem – solving investigations. It advocates the need for students to engage in all practical tasks, in which all aspects of knowledge (tacit as well as explicit) of practical ability and*

personal attributes of commitment and activity are interacting (Woolnough, 1994:125).

Kerr (1963) in his investigation into the purpose and nature of practical work in secondary school science has revealed that in the teaching of science education (chemistry, physics, and biology), doing practical work were: to encourage accurate observation, to promote scientific ways of thinking, and to provide an opportunity to find out facts and principles by investigation. 'Getting-to-know-by-investigation' experiments must be used more in science teaching.

A number of educators claim the significant place that practical work has in science education on the assumption that science is a doing subject and it is best learnt by doing it. They argue that doing science is giving students an opportunity to experience, experiment, observe, and find the relationship among facts; materials and events (Woolnough and Allsop, 1985; Romey, 1968; Parkinson, 1994).

Many other researchers in science education also depict that the purpose of practical work has been debating. For instance, White in Woolnough (1991) notes that there is no consensus about the purpose of practical work. Woolnough and Allsop claim three fundamental use of practical work as a central to scientific activity. These are (1) develop practical scientific skills and techniques (2) being a problem-solving scientists, (3) getting a 'feel' for phenomena'. Anderson (1976) as cited in Akalewold, states that laboratory teaching particularly served four purposes (1) the laboratory is a place where a person or a group of persons engage in human enterprise of examining and explaining natural phenomena (2) the laboratory provides the student with opportunities to learn generalized systematic ways of thinking that should transfer to other problem situations; (3) the laboratory experience should allow each student to appreciate and in part evaluate the role of the scientists in inquiry, and (4) result of the instruction should be a more comprehensive view of science including not only the orderliness of its interpretations of nature, but also the tentative nature of its theories and models (Boud et al 1989) in Akalewold (2003:70-71). Romey (1968) point out that laboratory experiment is a more effective way of arousing student interest. Furthermore, Matiru et al (1995) listed many possible proposes of laboratory work. Some of these include: teach theoretical material not presented elsewhere; arouse interests and develop skills in manipulation, observation, gathering and interpreting data, problem solving capacity, self-directed learning and independent thinking, communicating experimental results, personal responsibility and reliability of experimentation.

To sum up, all the literatures agree on the notion that all the purposes of practical work pointed out can be achieved only if students are provided with opportunity to be involved in the necessary experiences.

2.1.3. Types of Practical Work

Practical work is said to be a *sine qua non* of school science by a number of researches in the filed (Matiru et al, 1995; Arzi, 1998; Woolnough and Allsop, 1985; Tamir, 1991; Lunetta, 1998). They suggest that ... in practical activities students teach themselves and each other and learn essentially through their own efforts under the careful preparation and guidelines of the teacher. Akalewold (2003) points out that in designing a course for practical work the major part of the design next to decisions of aim and objectives is to make a right balance of concept development, skills development, and motivational aspect.

Various attempts have been made to classify different kinds of practical work in order to define their respective roles and purposes. Woolnough and Allsop (1985) suggest that practical work should involves three distinct types: *exercise*; by which practical skills and techniques are developed, *investigations;* by which practical based on problem-solving that give pupils the opportunity to tackle more open-ended tasks, and *experiences*; by which pupils get a feel for phenomena' (Woolnough and Allsop, 1985: Brown, 1995; Akalewold, 2003:73).

Matiru et al., (1995) listed five types (1) demonstration (2) exercises (3) structured inquires (4) open-ended inquires, and (5) projects. Woolnough (1991) with little modification shows four main types: exercises, experiences, demonstrations, and investigations, each of which has its own place in science teaching. A field works are likely to include aspects of these functions (Akalewold, 2003:73). As Parkinson (1994) practical work generally falls into one of the following four categories (1) learning basic practical skills (2) illustrating a theory or concept (3) proving a theory, and (4) investigative work.

Gott and Dugan, (1995) also recognized five broad types of practical work developed by Gott et al (1988). These include (1) skills to acquire a practical skill (2) observation; frame work in relating real objects and events to scientific ideas (3) Enquiry; to discover a concept law or principles (4) Illustration; to verify a particular concepts, law or principles (5) investigation; to provide opportunities for pupils to use concepts, cognitive and skills to solve a problem.

Besides, the educators also note that the boundaries are not claimed to be water tight; practical activities can clearly include more than one aspect. Particularly skills and observation are implicit to some degree in the other types.

On the other hand, researchers found out the related misconception problem of teachers towards practical work. That is teachers have been showed a tendency to accept that doing practical work regularly is a 'good thing' with little though as to its purpose. With regard to these related problems (Hodson, 1992) as has been cited by Gott and Dugan to have said as:

> *... a lot of what goes under the name of practical science is muddled and with out real educational value ... a major goal of practical work should be the engagement of students in holistic investigations in which they use the process of science both to explore and develop their conceptual understanding and to acquire a deeper understanding of (and increased expertise in) scientific practice (Gott and Dugan 1995:23)*

From proceeding explanation, it is possible to identify that practical work is the center of teaching learning process of science education

2.1.4. Method and Approaches to Science Teaching

Science teaching has existed for about a century and the approach has undergone many changes during this time During that early time there has been emphasis in turn on *clear demonstration*; then on *laboratory work* through 'heuristic' system, and in the last on *a blend of demonstration lessons and laboratory training* (Parkinson, 1994;Gleen 1965)

Traditionally science courses have laid the greatest emphasis on the recall of knowledge and the understanding of content. It has been depicted in schools as a list of statements, rules and laws to be copied down and learned by rote (McComas, 1998, Parkinson, 1994; Romey, 1968; Matiru et al, 1995; Layton, 1990; Lunetta, 1998).

This traditional approach to science teaching was based on the view that science consists of stable and immutable body of facts which are final and absolute. As a result its teaching has focused on helping students learn scientific facts, concepts and principles. However, the teaching

of science based on this understanding fails to convey the real nature of science subjects (Robert, 1972; BSCS, 1987; Mekunent, 1992; Romey, 1968). Romey, comparing the traditional and modern approaches to science teaching stated that:

> *... the (traditional) teaching of science can be compared to the teaching of art. Some art schools stress the history of art, where as others are more concerned with studio art; actual painting or* sculpture. *The difference between the two approaches is that one produces art historians where as the other produces artists. The same is true to science.(Romey, 1968:4)*

Thus as indicated above the traditional approach typically constitutes lectures supported by few practical demonstrations and the student remains a passive receiver of information who is supposed to reproduce it on examination or when ever demanded by the teacher.

However the inclusion of science education in the curriculum and science teaching in school has several functions to perform. Gleen (1954; 1965) Schwab, 1964 and Romey, 1968, stress that science teaching in school must give a student a systematic training in careful observation, in experiment and in the estimation of the relative value of results.

With regard to the method of teaching (as Martin et al., 2001) the emerging beliefs based on changing attitude towards science as researchers and educators imply is that *what* we teach may be less important than *how* we teach.

He also recognizes that, though no single methods of teaching has been found exclusively to meet all needs all the time, literatures emphasize the importance and benefits of inquiry- based teaching and learning. Other many writers in the field also claim the importance of inquiry approaches in teaching science (Romey, 1968; Schwab, 1964; Robert, 1972; Temechegn, 2001: 72; Mekunent, 1992)

Romey (1968) particularly, notes that inquiry based teaching method tend to focus on developing children's abilities to think than on mere acquisition of subject matter. Recent research verifies the superior effect of student centered constructivist approaches over traditional text based teaching methods for science achievement, and attitudes and skills of scientific enquiry (Martin et al, 2001; Mc Comas, 1998; Glatthorn, et al., 1998).

Many literature stress that science is a practical subject, and should be taught at all stages in a way which emphasizes practical, investigative and problem-solving activity. For example, Parkinson, advocating practical work approach state that...

> *.. science is not a catalogue of facts that have be fed to the pupils so that they can regurgitate it at the next examination. There is information to be learned, explanation to be understood skills to be mastered the approaches of science to be grasped. (Parkinson, 1994:4)*

Parkinson also observed that science courses developed during the last ten Years have placed greatest emphasis on the process of science arguing that for most pupils the scientific method is much more important than remembering scientific facts. Martin et al., (2001) in support of this added that:

> *... Science programs, science teaching practices, and assessment techniques must provide experiences that will help children to value and use science by making important discoveries for themselves.*

Today, researchers of science teaching and learning continue to regard problem – solving as a valued out come of science education. Science is most effectively taught and learned when both teacher and pupils practice the skills of problem – solving by engaging in group and individual study (Mc Comas, 1998; Marthin et al., 2001; UNESCO, 1969: 1979).

Champagne and klopfer (1977) in Barr (1994) also indicate the remarkable degree of most science educators that the problem solving and reflective thinking play an important role in children's learning of science in school. Based on this reality most science educators proposed and claim practical work method the best way of teaching and learning science, arguing that the first – hand experience through practical work is believed to be essential (UNESCO, 1969: 1979 ;Gleen, 1965 ; Romey,1968; Majasan 1995; Woolnough,1991;1994; Woolnough and Allsop,1985; Nordberg et al., 1962). Accordingly, some of the ways suggested being best for teaching and learning science education is. (1) experimentation (2) investigation based on problem – solving (3) Observation (4) demonstration (5) laboratory work (6) fieldtrips or visits.

On the contrary, Barr (1994) and Tobin et al (1994), remark that ... though the beliefs in problem-solving as a goal of school science is pervasive there is a disparity of some magnitude between beliefs and practice. Tobin, point outs that... *the focus of the implemented curriculum tended to be on covering planned content rather than insuring that students developed depth of understanding. Laboratory activities tended to be of a "Cook book" type with strong emphasis on following procedures on in order to collect data. There was little emphasis on planning an investigation or an interpreting result.*

In addition, he summarized from different literatures (Hofstein and Lunetta, 1982; Stake and Easley, 1978; Tobin and Gallagher 1987a) and suggests that widespread acceptance of the importance of laboratory activities in science curricula the practical work or laboratory activities fall short of achieving the potential to enhance student learning with understanding.

To sum up, the above discussion shows that, the nature of science course suggest certain teaching procedures those are particularly appropriate. Techniques of experimentation and discovery, laboratory work, demonstration, research projects and field trips must emphasize in teaching science.

2.1.5. The Emergence and Development of Practical Work in Science

Practical work began to emerge in England when the Department of Science and Art was established in 1854 and state support grants to set up and equip school science laboratories (Gott and Dugan, 1995).

The history of laboratory work for scientific enquiry started in chemistry tracing to the seventeenth century and subsequently extended to other disciplines. However, it was not part of a chemist normal education until the 19th century. (Layton, 1990; Arzi, 1998).

Practical work in science was a result of the 19th century. In the second half of the 19th century in both the UK and USA the ideology of pure science was considered strongly. Several researchers of science education show that the claim for practical work in teaching science since the late nineteenth have not remained constant. Consequently, there was a progressive curriculum shift in emphasis from science as useful knowledge to science as an activity which required no extrinsic justification (Layton, 1990; Arzi, 1998; Parkinson, 1994).

In the 1960s in both the USA and the UK, major curriculum of science aimed to engage students in investigation and enquiry as a central part of their study of science. And the issue practical work continues to have a prominent place in the rhetoric of science to day (Lunetta, 1998; Arzi, 1998; Layton, 1990; Gott and Dugan, 1995).

In these early days, the emphasis was much on demonstration by the teacher with a focus on illustration of particular concepts. Gott and Dugan (1995) note that:

> *... most of the practices at that time was consisted of following 'recipes' to verify theory or to illustrate concepts and, towards the end of this period, there was growing concern that much of this practical work routine and repetitive. Nevertheless, practical work had already established itself as a vital part of the science curriculum.*

Similarly, Lunetta (1998) and Matiru et al (1995) describes that, the progressive education movement in the early part of the 20th century advocated an investigative approach and laboratory manuals acquired a more utilization, applied orientation. By the middle of the century, however, practical activities were used largely for illustrating and confirming information presented by the teacher and textbooks.

Matiru, et al., (1995); Brown (1995), point out that during the past twenty five years, though a major re-appraisal of uses and methods in laboratory teaching has taken place, there is considerable controversy about it. Consequently, in the debate several areas of serious concern have been expressed. This includes:

1. The high cost of laboratory work, making it difficult to continue providing facilities and resources to the standard felt necessary.
2. Serve time constraints and over loading of time tables leading to serious problems in meeting syllabus requirements in quality and quantity.
3. Dissatisfaction with the effectiveness of conventional laboratory work which does not foster the understanding of scientific concepts and application of scientific principles in solving problems.

Many researchers depict that synthesis of research conducted since the science curriculum reforms of the 1960s raise questions about the value and effectiveness of laboratory work (Hodson, 1993, Lunetta of Holstein 1991; Lazarowitz and Tamir, 1994; Tobin, 1998; Arzi 1998). For egample, Arzi criticizes the existing research as failing to address crucial issues regarding what actually could be expected from practical work.

Hodson (1993) also points out that the mismatches between goals and activities which subsumes an unwarranted expectation that practical work of any kind serves all purposes. They reasoned out that the effectiveness of practical work varies for different goals, and argue that careful – designed laboratory activities with appropriate physical facilities can make contractions to most aspect of science education.

A number of researchers posited in support of practical work in school science. For instance, Woolnough and Allsop (1985) provide evidence in support of separating content from process and concentrating practical work on the development of process skills. Similarly: Igelsrud and Leonard (1988) and Tamir (1976b) in lazarowitz and Tamir (1994) emphasize the distinctive and indispensable role of the laboratory.

Lazarowitz and Tamir (1994) also note the following points from the research related to laboratory in science teaching: These are: (1) there is little reference in the review to science in the school, even though hands-on experience is essential for meaningful learning at this time (2) certain issues related to the students laboratory, such as separation or integration of content and process, have remained controversial in spite of research conducted; (3) improving research by formulating more 'telling' questions and using better research design has remained a major challenge even in the 1990s; (4) it is still necessary to provide sound empirical support for the role of the laboratory and the steps that are needed to ensure that the potential of the laboratory will be realized.

2.1.6. Practical Work and Goal of Science Education

Several science educators have expressed the view that the uniqueness of the practical activities lies in providing students with opportunities to engage in scientific investigation and enquiry (Lunetta and Hofsten, 1991; Arzi, 1998; Romey, 1968; Hegarty, 1990; Woolnough, 1991; 1994).

A number of opinions exist in the goal of science teaching. Parkinson (1994) shows five broad statements to cover the important facets of all science courses. These are to enable the learners to (1) appreciate science of human activity (2) understand how science operates (3) know and understand scientific concepts and principles (4) be able to be scientific, and (5) relate scientific enquiry and action to other modes of human behavior. Akalewold (2001) summarized the two views on goals of science teaching synthesized by Bybee and deBore (1994). The first view states that the student should have some knowledge of the products of science, experiences with and understand the method of science and should understand how science serve as a force in their life. This includes the goals: (1) to acquire scientific knowledge (2) to learn the process of methodologies of science; and (3) to understand the application of science. The second view is concerning the ends to which the knowledge, methods and application apply. Here the goal includes (1) personal development (2) social efficiency and effectiveness (3) the development of science it self; and (4) national security.

Bybee and Ben-Zvi in Fraser and Tobin (ed) (1998) also indicate that, through out the history of science education three major goals for students have been (1) to acquire scientific knowledge (2) to learn the procedure or methodologies of science, and (3) to understand the application of science, especially the relationship between science and society.

Science educators through time continue to examine and determine what these major goals mean in curriculum, which include (1) enhancing personal development, which includes aesthetic aspiration, intellectual development and career awareness (2) maintaining and improving society, which includes the maintenance of stable social order, economic productivity and the preparation of citizen who feel comfortable in a scientific and technological world, and (3) sustaining and developing the scientific enterprise itself the goal that evolves the transmission of scientific knowledge from one generation to the next and the formation of scientifically enlightened citizenry sympathetic to the importance of science as a field of enquiry (Bybee and Ben-zvi, 1998).

Literature in the field suggest that science curriculum should continue to work towards integration of three major goals of acquiring scientific knowledge, developing the abilities of science to personal decision and societal challenges (UNESCO, 1969; 1979; Lazarowitz, and Lazarowit,1998).

As the literatures show practical work in science education assumed various purposes. Baez (1976), summarize five goals of innovative activities should be carried out in science teaching.

In order to achieve these goals of science education practical work method is indispensable. With regard to this Lunetta and Hofstain present an out line of intended learning out comes of laboratory works in science education (Lunetta and Hofstein, 1991:130).

Table 1Goals of Practical Work in Science Education

Domain	Goal
Cognitive	- Promote intellectual development - Enhance the learning of scientific concepts - Develop problem solving skills - Increase understanding of science and scientific method
Practical	- Develop skills in performing science investigation - Develop skills in analyzing investigative data - Develop skills in communicating - Develop skills in working with others
Affective	- Enhance attitudes towards science - Promote positive perceptions of ones ability to understand and to affect one's environment

Source: (Lunetta and Hofstein, 1991:130)

2.2. Practical Work and Its Importance in Biology Teaching

2.2.1. The Need and Importance of Biology Teaching

As several literatures in the area depicts, it is interesting to speculate why we teach biology or any other subject for that matter, at all. The goals of education in biology may vary from country to country, or even from region to region in a country. *BSCS (1993)* publication gives the goals of an education in biology as follows. A biology literate individuals should: *(a) understand* (i) the unifying principles and major concepts of biology (ii) the impact of human on biosphere (iii) the process of scientific inquiry (iv) the historical development of biological concepts *(b) develop appropriate personal values about* (i) scientific investigations (ii) biodiversity and cultural diversity (iii) the impact of biology and bio technology on society (iv)

the importance of biology to the individual (c) *be able to* (i) think creatively and formulate questions about nature (ii) reason logically and critically and evaluate information (iii) use technologies appropriately (iv) make personal and ethical decisions related to biological issues, and (v) apply knowledge to real world problems.

Several researchers in the field depict the many facets of biology and its teaching as a school subject. They state that, ...of the family members of the pure science taught separately as part of school education Biology is the one most directly concerned with us human beings and part and parcel of the animal world On a general note, Biology as a science will contribute to the acquisition of special ability in laboratory techniques and skills in observation, experimentation and documentation. Also the ability to apply scientific knowledge to everyday life in matters of personal and community health and agriculture will be greatly enhanced (Majasan, 1995; Brown, 1995; Dallas, 1980; Gleen, 1954; 1965; Miller and Blaydes, 1962).

Bentley Glass in reference to good teaching of Biology in schools said that:

> *... the aim of the biological science curriculum study is to place biological knowledge in its fullest modern perspectives. If we are successful, students of the new biology should acquire not only an intellectual and aesthetic appreciation for the complexities of living things and their interrelationships in nature but also for the ways in which new knowledge is gained and tested, old errors eliminated and an ever closer approximation to truth. Bentley Glass (1964) in Majasan (1995:237).*

Hence, to make teaching-learning effective teachers need to use appropriate teaching methods and techniques (MOE, 1999; Brown, 1995). *Anderson (1972) notes that "... in teaching, content and method are intricately intertwined. The most sophisticated methods are of little moment if there is nothing to teach. However, profound content can be lost, in fact negated, if the methods of teaching are haphazard and at variance with the nature of the content."* Especially in science teaching, the nature of the discipline, science, may in part be communicated by the way we teach.

The pedagogy that has emerged advocates that students engage intellectually with meaningful laboratory experience and data with which they can construct shared understandings of scientific concepts in a community of science learners in their class rooms (lunetta, 1998).

The field of biology has undergone a remarkable transformation from descriptive science to investigation of the molecular and environmental factors influencing biological organization and activity. As a result new approaches to biological investigation require new pattern of teaching to complement diversity (Anderson, 1972; Miller and Blaydes, 1962; Gleen, 1965).

Dallas (1980) suggest that ... there is no one way of teaching biology, just as there is no definition of the factual content covered by the term; it can range from the *exact* sciences of physics, chemistry and mathematics, to the *inexact* and exciting realms of human behavior. Biology defies classification as one particular form of knowledge as it must necessarily deal with all kinds of disciplines.

So in teaching biology, it is wise to look at methods of teaching other than those with which one was taught. BSCS (1965) indicates that the study of biology involves a series of processes. As a result, today using a film rather than live animals used to be regard as low –grade teaching, as it provides evidence at second-hand rather than first –hand.

Gleen (1965), Majasan (1995) Brown (1995) Dallas (1980) strongly suggest that if the teaching of biology is to make its maximum contribution to the education and well-being of the child and society, biological education must start early in school life in the form of nature study and must have strong practical bias. They underlie that as a fundamental rules, it must be practical process in which pupil, at every stage is an active participant who deals with things, organisms, situations and events, in stead of being merely a passive recipient of verbal instruction. The emphasis must be on activity, upon exploration and experimentation.

To summarize this topic with what Volpe suggested with regard to this is shown below:

> *...the study of science alienated from the life of the student. Thus, the challenge of education is to expose students to learning experiences that will make the scientific outlook part of their daily living. Therefore, teaching science need to be structured to meet that urgent challenge. It presents those aspects of biology that have daily import in a person's life (Volpe, 1993:I)*

Thus, one can realize that biology is an important subject and many biological studies today are aimed at solving problems related to our daily life. And findings in biology are believed to bring a bout drastic change in the life of society as a whole.

2.2.2. Practical Work in Biology Teaching

Practical work has a profound place in teaching biology. According to Dallas practical work is a pillar of biology teaching wisdom. Several literatures stresses that science is generally seen as practical subject and practical work is fun (BSCS, 1971; Majasan, 1995; Dallas, 1980; Parkinson, 1994; Brown, 1995).

Despite the fact that each has its own specific field, pure sciences are interrelated, interconnected running into one another in many areas and sometimes all joining together to give full explanation for some occurrence in nature (Brown, 1995). As a result teaching a biology subject involves considering the same procedural issues discussed in teaching science education. In other words, the methods of teaching science and what is suggested for teaching science education in school is equally important in any science in which 'doing' make teaching-learning effective (Gleen, 1954; 1965; Brown, 1995; Dallas, 1980; Parkinson, 1994).

Furthermore, Majasan (1995) stresses that... *Biology is a science and that science is based on investigation which produces enduring facts which become knowledge. So the right approach to gaining biological knowledge must be through investigation which comprises observation, examination or experimentation and deduction through all the stages of learning-preschool, elementary, secondary, and tertiary.*

On the other hand, a number of researchers show the most frequent fault with biology as taught in many schools. That is observed the content is too formal and its methods *unpractical.* Children instead of developing attitudes and interests, they are far more often struggling to learn details, especially of structure, and are overloaded with words beyond their comprehension (Gleen, 1965; Miller and Blaydes, 1962; Irene, 1958).

Thus teaching of biology suffers from the kind of verbal approach teaching. Gleen (1965) suggests two points, in particular which require special emphasis in teaching biology (1) Biological education must be practical (2) Biological education must be social.

According to several educators the purpose of practical work in biology (when resources are used in activities performed by small group of pupils) are: (1) developing an understanding of (a) structures (b) processes in living organisms (2) developing skills in (a) manipulation (b) the process of science (c) conducting whole scientific investigations. Clearly, teaching biology

well rests on sound general principles of effective teaching but, additionally, it carries unique possibilities and demands because of the subject matter with which it is concerned (Brown, 1995; Dallas, 1980; Millar and Blaydes, 1962). Thus as it can be understood from the discussion, PW method is an essential and central to teaching biology.

2.3. Factors Influencing Practical Work Implementation

A number of researchers and educators in the field note a number of factors influencing the implementation of practical work in science teaching. Lack of laboratory and laboratory equipment, school facilities and resources, curricula, large class size, shortage of time, attitudes towards practical activity, teachers methodology of teaching and preparation are some to be mentioned (Miller and Blaydes, 1962; Allsop, 1991; Akalewold, 2001; 2003; Irene, 1958; Barr, 1994; Mekunent, 1992).

Parkinson, (1994) similarly, indicates the difficulty that schools found to implement the national science curriculum of 1988, in the UK. These include lack of suitably qualified staff, insufficient equipment or laboratory space, unavailability of suitable teaching resources. Yet, to conduct practical work requires energy, time, and resources. One of the ways to improve the science curriculum is to complement school laboratory activities (Lunetta and Hofstein, 1991).

Kerr (1963) also identified obstacles impeding achievement of the possible rewords of learning science through practical work. .He found out that, the efficiency of laboratory work in science teaching is impaired by a variety of causes; of these the series once are (a) shortage of well-trained science teachers, (b) the full time tables of science teachers, (c) insufficient laboratory facilities (d) shortage of time.

A number of educators show that there is little reward for changing teaching strategies of classroom organization to emphasize high-level cognitive learning of problem-solving if system wide, state, and national assessment continues to evaluate the recall of factors. If assessment directly parallels academic work there is little encouragement for students to take risks and thinks divergently. Alternative approaches to assessment need to be developed and researched (Barr, 1994; Mekunent, 1992; Akalewold, 2001; Tamir, 1998; Black, 1998; Parkinson, 1994).
Briefly, factors that influence proper implementation of the practical work in science teaching are diverse. The concern here, however, is with four major factors namely, curricula, resources

and school facilities, attitudes and interests towards practical activity and teachers and teachers' methodology of teaching.

2.3.1. Curricula

In the preceding section, it has been stressed that science curriculum should provide ample opportunities for the development of enquiry process in students. That is, the textbooks, the practical work experiences and other accessory curricular materials should convey a sense of recommended science teaching strategies.

Among the many abstract concepts in educational literature 'curriculum' probably belongs to the most elusive ones. The concept evokes different meaning to different persons (Akker, 1998) Nevertheless, curriculum is said to have been more known than explained. Beside misconception and its nature, it still remains the most decisive element of the school system. To make the concepts clear or it is helpful to clarify the intended meaning, scope, and context of the term. In this topic the focus is made on the instructional materials the textbooks, the laboratory experiences or practical activities and other accessory curricular materials and learning experiences.

Akalewold (2001) clearly indicates that ... the nature of classroom transactions is strongly dependent on the curriculum materials, in (1) a laboratory manual consisting of a series of exercises or investigations that may or may not be integrated with non-practical exercises, or (2) work sheet or (3) textbook that includes laboratory exercises.

Temechegn (2001) showed the several points of critics of African science education lack of relevance to the needs and interests of children and the need of including indigenous knowledge and native technology into the science curriculum is much stressed

Several researches in the field point out that... even curricula claiming to be enquiry-oriented such as BSCS, PSSC and CHEM study offer by and large, practical exercises which reflect a very low level of enquiry (Herron, 1971; Tamir and Lunetta, 1981) cited in Friedler and Tamir (1990). They all suggest that, ... while some confirmatory laboratory exercises which aim at developing self confidence as well as basic processes and techniques may be necessary, the majority should require student to engage in real problem-solving investigations, reflecting

different levels of scientific enquiry according to particular goals and local conditions (Friedler & Tamir, 1990; Akker, 1998).

Gardner and Gauld, (1990) indicates that designing high quality curriculum materials is not easy. Particularly it is demanding with regard to enquiry-oriented laboratory investigations because of the need to try to experiments to make sure they "work" as well as the importance of having "balanced" exercises in terms of their "cognitive challenge'. One of the major features of the 'new' curriculum in the UK and USA in the 1960s was extensive use investigative laboratories. Furthermore, Shomanky's definition of the "new science curricula" in Mekuanent (1992) summarizes that has been said above. He defines science curricula as programmes which:

> *(1) emphasizes the nature, structure, and processes of science; (2) integrate laboratory activities into case discussion; and (3) emphasize higher cognitive skills and an appreciation and understanding of the nature of science.*

In general the above literature depict that the curriculum has contribution for the law status of practical work in teaching biology. Therefore, as the teaching materials, particularly the textbook is the basic tool of instruction is school curriculum. Thus it is essential to consider the approaches to be used in the curriculum materials that would suit the practical work implementation.

2.3.2. School Facilities and Resources

As several scholars agreed on, in order to get the best out of pupils, science laboratory needs to establish a happy and encouraging working environment that portrays positive image of science (Parkinson, 1994). Lunetta and Hofsten confirm that laboratory activities constrained by school realities such as forty minutes laboratory periods, safety, budgets and other resources. Akalewold (2001) from Shoultter (1984) Ainley (1978) Davis (1972) summarized that in the absence of sufficient laboratory facilities there would no be meaningful learning and purposeful involvement of student. Thus, the provision of equipment and materials improve patterns of teaching science.

Millar and Blaydes (1962) show the comments by teachers suggest that adequate facilities led to greater use of laboratory work and exploration as a vehicle of learning. Several

studies showed that lack of materials, equipment and facilities was a major impeding factors to laboratory activities.

Researchers recognize that, in a classroom occupied an excess of students, there is little opportunity for individual work or use of laboratory supplies (Millar and Blaydes, 1962; Allsop, 1991; Irene, 1958). For instance, Allsop (1991) observed the greatest difficulties that low-income countries, especially from sub Saharan Africa, has in providing the normal facilities of trained teachers, laboratories and equipments for teaching science: Among the other, he point outs that: very large classes, often with 60 or more pupils working in very cramped conditions, set organizational challenges in relation to the delivery of practical science which would deter most teachers.

It is understood that with the classroom, the number of student or the class size has inversely negative effect on practical work implementation. The teacher smaller classes can manage individual or small group of students. Students and teachers, evaluation and control of activities and assignment of achievements are becoming very difficult to realize in our school system.

Allsop evidences the survey conducted by Varghese (1988) in 50 Zambian secondary school found that only three had adequate facilities for practical sciences, and even in these only demonstration experiments were performed by the teacher, equipments and chemicals being conserved for use in practical examination.

Laboratory with sufficient quantity of equipment is a place where learning in science begins and ends in delight. Here the attitude of students to enquiry and openness and questioning encouraged (Roth, 1998; Lunetta, 1998; Baez, 1976; Allsop, 1991). In general resource constitute a serious problem which is more worse in the rural areas, particularly in respect of predominantly rural schools which are traditionally under-resourced with necessary school facilities and trained and experienced teachers.

In addition, Fraser, (1998) remarks that facilities available for use in science teaching can determine to a large extent the students' opportunities to learn. The other series problem is time allowed. The success of an experiment depends not only on the ability of the performers but also on the careful preparation by the teacher.

Lunetta and Hofstein (1991) state that laboratory activities are generally constrained by school realities. Adequate time have a positive correlation with effective preparation and work with laboratory for the teacher and with students who are engaged in practicing.

In biological science, laboratory practical activities have the distinct advantage of enabling students to work with real materials and phenomena and to experience their biological and physical environments. Students need direct experiences with organisms, materials, and phenomena (Fraser, 1998; Lunetta and Hofstien, 1991). They may do this through contact with living specimens in the laboratory and in the field.

A biology classroom conserves a laboratory functions, provided that it is properly designed and equipped. J.A. Majasan (1995) state that,

> *"... for a good school education in biology there must be a well equipped laboratory where good drawings, pictures and specimens are nearly kept, for constant use. ... Microscopes and slides are part of the equipment of a good laboratory from where practical knowledge should ooze off the acknowledged scientific method of observation, examination or experimentation and deduction made use of by keen, creative and hardworking students".*

Nordberg et al (1962) similarly, remarks that the teacher is fortunate indeed if he/she meets a situation of small classes, ample laboratory space, well-stacked supply rooms, sufficiently long laboratory periods and the like. Akalewodl (2001) also shows that science laboratory work must accommodate and emphasize the lab work that allow the individual student to work in a cooperative atmosphere and yet affirms the need for individual advancement in understanding science and the use of process skills. In general, literatures show that, in the excellent science classroom there is a sprit of enquiry, laboratory activities and experiences.

2.3.3. Attitude and Interests towards Practical Work

Literatures indicate that, the development of positive attitude towards science has been regarded as a legitimate goal of science education and is well reflected by inclusion of effective aims in most science curriculum materials. Toh (1991), shows that the attention of effective variables seems to stem from the belief that they are as important as cognitive variables in

influencing learning outcomes. Gardiner and Gauld (1990) remark, *students generally enjoy lab work... not all enjoy it equally, and even a students who usually enjoy it may find some aspects of practical work unsatisfying.* Similarly, Hodson, (1993) from research literatures added... while many children enjoy practical works and develop positive attitudes to it, there are many who do not, and some others also expresses a 'dislike' for PW. Research also confirms the consistent differences in attitudes to and interest in PW between girls and boys. Murphy, (1991), shows boys often appear to be more active and involved in practices than girls. Head (1985) in support of this argue that 'the ability to perform task and a willingness to do so are necessary of success' by clearly indicating and determining the personal response of the individual to the learning situation (Head, 1985) in (Toh, 1991).

Laboratory work obviously occurs as a result of the attitudes and decisions of educators (Gardner and Gauld, 1990). In their work focusing on the link between laboratory work and students attitude observed that

> ..."*laboratory work, not only provides science students with experiences which foster cognitive development and psychomotor skill: it provides opportunities for enhancing their scientific attitudes and their enjoyment of science as well.*"

Generally, researches confirm that, students have generally enjoyed lab work. Of course, the generalization is, however, very sweeping; not all enjoy it. Among the physical conditions, laboratory facilities can have effects on arousing attitude to science. Many studies found a positive association of students' attitudes with school laboratory facilities.

The availability and quality of lab facilities, together with the quality of the educational events that take place with in the laboratory practices, do affect student interest in science (Gardiner and Gauld, 1990). Lunetta (1994; 1998) also suggests that with appropriate teaching strategies, relevant practical activities can help students to identify alternative conceptions, can motivate their learning.

2.3.4 Teachers' Methodology of Teaching

The teacher has many challenging roles to play in engaging students in appropriate practical activities. It is a teachers' job to try to unravel pupil's original ideas and guide them on

the path to understanding the accepted views on science. That is in serving as co-inquirer who models appropriate problem solving in facilitating discussion of scientific practices, concepts and theories, in sensitively sharing strategies and explanations of the scientific community and in engaging students in relevant concept building discussions (Martin et al 2001; Roth, 1998; Lunetta 1998; parkinson, 1994).

Here the question that will be dealt with is what (Brown, 1995) recognizes as central "what are we going to teach (what will be the outcomes of the lesson,
What will the pupils gain as a result of it? And how are uses going to do it (what teaching methods will us to employ?)

Teaching science is on-going learning process where practice is constantly reviewed and new, more effective techniques used many of the teaching techniques used in the past are valuable but there are many new ways helping pupils to learn (Parkinson, 1994)

> *The teacher's task is to nurture the enquiry emphasizing the process of enquiry and inducing student to reflect on it. He /she has to be careful that the identification of facts does not become the central issue and should encourage good level of rigor in the enquiry. The instructor's task is to turn the students toward the generation of hypothesis, interpretation of data, and the development of constructs, which are seen as emergent ways of interpreting reality (Joice and Well, 1986:139). In Mekunent 1992/*

It has been stated that the major objective of teaching science is to help students develop the competencies and habits related to enquiry process; since these processes are the key to the understanding the nature of science. Thus, the attainment of these objectives therefore necessitates a radical shift from the conventional approach to teaching science.

It is essential that through good teaching i.e. having a sound knowledge of the subject and making a work interesting through variety of approaches and patterns of working teachers can encourage pupils to study science (Brown, 1995). Much more important is the question of whether the pupils are actively engaged in their learning. It is essential that science teacher should think clearly a bout what s/he wish pupils to gain from the lessons and then select the

most appropriate means of achieving that. Knowing what to use, how to get, and haw to use for a lessons, careful planning and management, not only of pupils, time, books and other resources, but also of apparatus, chemicals and the relevant materials involved is well to remember among the others (Brown, 1995 Nordberg et al 1962; Dallas, 1980).

Fraser (1998) and Arzi (1998) from literatures conducted with regard to teacher factor in science classes infer that, the extent of which a given science environment enhance science education depend on the teacher's subject-matter knowledge pedagogical knowledge beliefs and ingenuity in the use of the available resources motivation on the particular physical features of any facility.

The essential preconditions are in keeping the ideas that attainment of stated objectives requires using '*the most effective means of teaching with in specified limitations and structure of the syllabus*' (Meyer, 1969:5). Methodology as the core of pedagogy or the teaching profession it is the main tool of the teacher with all the other as a support to make him sound, effective, and result-oriented (Majasan, 1995; MOE, 1999; Parkinson, 1994). Allsop (1991) in his research conducted in sub Saharan Africa found outs that, most primary teachers have a personality limited background in practical science and slight confidence in teaching methods other than exposition.

With a well articulated school course it becomes the teacher's responsibility to animate his lessons to produce biology enthusiasts through his own competence, interests and personal approach. Methods is often affected by factors external to educational suitability such as lack of finance for purchase of equipment, lack of adequate classroom space etc. (Majasan, 1995; Gleen, 1954: 1965; Miler and Blaydes, 1962).

Several studies have highlighted the problem teachers face in managing students is laboratory activities. For example Tobin et al., (1994) indicates that teachers have difficulty coping with management of disruptive behavior and the learning need of students in laboratory setting. The extent to which students are cooperative and motivated to learn obviously makes a difference to the efficacy of laboratory activities.

Drothy dallas advises as has been quoted by Brown (1995) to have said as: that;

... teachers need to look critically at proposed practical work it is merely recipe following with out comprehension, the ... the

equivalent of sand and water play in the nursery school ? or are the class really earning from it ? (Dallas 1980) in Brown, (1995:21).

Roth also noted that practical works are most productive when teachers view and conduct them selves as co-explorers rather than administrators of knowledge (Roth, 1998:254).
Martin et al., (2001) in support of this stress that inquiry is the Cornerstone of teaching and according to NSES (1996:4) good teachers at all age and grade level are expected to be able to plan inquiry - based science lesson and science programs, take proper action to guide them and facilitate learning, assess teaching and learning, and develop and maintain class room environments and that enable children to learn science.

The ideas about learning that teachers hold has implications for the teaching strategies they choose to use in their lessons. As a result teacher's knowledge of students learning based mainly on teachers' own style of learning affects practical work implementation. (Parkinson 1994) Barr (1994) also suggests that ... *pre service teacher preparation programs in science should link with pedagogy in order to enable teachers to become flexible in their thinking, receptive to change and innovation, questioning in their outlook, aware of their own perception and assumptions, open to a wide range of alternatives reflective in their thinking. Glatthorn, et al., (1998) and* Mc Comas (1998) also note that science teacher has to master his/her subject matter, and the techniques of making it interesting intelligible to students.

In general laboratory work is stimulating and rewarding for pupils, and helps them enjoy science while doing it, so the argument goes (Olson, 1994). There is common agreement almost among several school science researchers that the teacher is undoubtedly the key factor in realizing the potential of the laboratory. Friedler and Tamir, 1991 argue that *"Teaching in the laboratory requires a special approach to science, (e.g. science as enquiry) special instructional skills (e.g. running pre-lab and post-lab discussion). Special management skills (e.g. budgeting time, managing small groups, guarding safety), and special attitudes (e.g. patience, tolerance, of uncertainty, readiness to encounter failure, open-mindedness).*

Although the role of the teacher is that of facilitator, it should be remembered that he/she point outs, however good are the textbooks designed and unique the laboratory experiences provided: the science teacher still serves as the interpreter of these things to the students, and is at the center of the teaching-learning situation. The success of the lesson depends on what the

teacher does to sustain the practical process. In short he/she has to create the appropriate classroom environment where ideas can flow freely between the teacher and students and among the students themselves.

2.4. Development of Science Education-An Overview of Ethiopian Context

The existence of science education in Ethiopian school system can be traced back to the year 1990s, when modern education for the first time, was introduced to the country. In this section, the attempt was made to present the introduction of modern education into the country and the major events of the development of science education briefly.

2.4.1. Modern Education in Ethiopia

Ethiopia has a long and rich history of educational traditions. Ethiopia's early Christian heritage starting form forth century represents an important element of education in the country that become a formal indigenous institution (Wube, 2005). The Mosques in the Muslim area, like church, had run Quranic School that probably appeared in the eleventh century in Ethiopia.

In general the aim of traditional education was to provide moral and religious education. The curriculum of both church and Quranic is largely unchanged and contested i.e. the contents are considered to be true, ever lasting and worthwhile (Wube Kassaye, 2005). Girma Amare (1982) indicates that *...Its curriculum too did not remain strictly religious but also highly conservative, discouraging inventiveness, curiosity and critical mindedness.* It is clear that, the system with no doubt, among other things, contribute to the deterioration of the ancient civilizations and economic development of the country by large.

Generally, until the end of the ninteenth century, education was totally in the hands of church which neither bothered to expand it nor to make it relevant to the socio-economic need of the country.

Modern education was officially started in Ethiopia by the opening of Menelik II school of Addis Ababa in 1908. This late introduction of modern education was not accepted easily because of the opposition from the clergy and aristocracy but in the year mentioned above, several factors such as post-Adawa situation necessitated the need of introducing modern

education in the country. Among the factors behind the introduction of modern education include the establishment of central state authority and permanent urban seat of power, the development of the modern sector of the economy, the arrive of the foreign embassies, the need for maintaining the sovereignty of the country, and readiness to accept innovation particularly in the scientific and technological fields (Wube, 2005:53-54).

The other reason could be the then emperor Menelik's attitude towards eagerness for innovations, attempt to break down some of the detrimental social customs and sending Ethiopians to abroad for study With regard to the return to the capital *victoriously from the battle of Adwa, Punkhurst (1962:256)* as has been quoted by Akalewold to have said as *"we need educated people in order to ensure our peace to reconstruct our country and to enable it to exist as great nation in the face of European powers"*. (Akalewold, 2001).

In general several researchers on the issue shows that until the end of the nineteenth century, education was totally left in the hands of the church which neither bothered to expand it nor to make it relevant to the socio-economic needs of the century.

2.4.2. The Development of Science Education

With regard to this section researchers observed that there is no adequate literatures published on Ethiopian science education that would give a general picture of science education and science subjects in particular, (Temechegn, 2001:70). Any how the following works present some major events.

The introduction of science and technology in Ethiopia can be traced back to the 1940s (Berhanu, 1994: Marew,2000) during the period (1908-1946) there was no single, uniform and standard Ethiopian school curriculum developed and implemented by Ethiopia for Ethiopian. Subjects taught, period assigned to teach subject area and many other things showed a good deal of variation from one school to another in the country, (Marew, 2000). Science education during this period of time was characterized as imported or colonial type of education.

In general, teachers were expatriates and teaching materials were imported from foreign countries (Berhunu, 1994; Marew. 2000; Akalewold, 2001) The year 1947/8 is a unique in the history of curriculum development and implementation in Ethiopia. It was during this time that the first formal written curricula for six year elementary and six years secondary education were

published. Researchers, note that science appeared as a subject first in the 1946 curriculum version. Since then it continued as part of the school curriculum. History of science and technology education in Ethiopia shows that science teaching has undergone continuous change in its objective, contents, teaching-learning methods and curricular materials (Berhanu, 1994; Marew, 2000, Agdew and Zewdneh (1982) in Akalewold (2001), After the expulsion of the Italian, in 1941, to over come the destruction problems made by Italian the main concentration was on the production of teachers and various personnel for the state activities (MOE, 1996:90; Marew, 2000; Wube, 2005). The curriculum specification to be offered for the elementary school level include natural science as one subject starting form grade 3 through 6 and science and health at junior secondary grade 7 and 8. The materials were adapted to the country as they were and the teaching of science was strongly teacher centered emphasizing memorizations (Berhanu, 1994; Akalewold, 2001; MOE, 1996:90; Wube, 2005).

During the above years, an Ethiopian experience (culture) in education was not well developed. Curriculum developers and researches were not available. Still curriculum development and implementation was influenced by the aristocracy and their advisors of different origin and interest (Seyoum, 1996:4). No evaluation and researchers were made to improve the curriculum. Rather it was generally dominated by foreign experience (Wube, 2005:55; Marew, 2000)

After the late 1950s the structure of education changed from 8-4 to 6-2-4 structure-six years of elementary period, two years of junior secondary and four years of senior secondary level that comes into full operation in 1963 – 64. Among the various reasons necessitated the change was, the need to adopt the imported textbooks to national needs started in the year 1955 by the Ministry of Education (ibid)

Since 1960s, science education has undergone worthwhile changes globally. The countries like U.K. and USA initiate curricular innovation in the field of science. The PSSC, BSCS, and Nuffield science education were examples of science curricular innovations took place in UK and USA.

As to UNESCO (1987) and at the same time with the curricular innovation movement in UK and USA, most African countries got their independence and start to question the relevance of the imported curricula to their countries socio economic development had effected curricular

changes in Africa in general and Ethiopia in particular (UNESCO 1987;) Hence, science text book for primary schools and science for young Ethiopia, for grade 7 and 8 was adopted the textbooks of USA, and these teaching material emphasis learning by doing (Berhanu, (1999); Akalewold, 2001)

For both the primary school and junior secondary 'ሳይንስና ህይወት' and 'science comes to life' science text book respectively were written locally in the 1970s. The origins of these text books were from African Primary Science Program (APSP) and Nuffield Science Course materials. These teaching materials are known by its inquiry approach (Berhanu, 1994).

Immediately after the 1974, when the military group known as Derg replaced the Haile Silassie regimes, the transitional curriculum consists of academic, vocational and technical subjects was prepared on effort to comply with the new ideology socialism. The curriculum during this period was centralized, and all the materials were developed in the curriculum department of the ministry of education (Wube, 2005; Seyoum, 1996).

In general, after 1975, the most obvious changes in the polytechnic education the amount of time given to science teaching overall is increased, and science curriculum is specialized environmental science is introduced in the first grades and biology, chemistry and physics taught as a separate subject in grades 7 and 8 (Marew, 2000).

Even though, the Ethiopian science curricula remained unchanged for years several years, since 1960s science education has been globally changing. Educators and scientists felt that the science curricula of the 1970s lack social relevance and purposes. As to Berhanu, (1994) in the 1980s, UNESCO helped science to be relevant to the students' life and social needs. Accordingly, it is expected to serve as a means for problem solving include basic scientific knowledge, relate itself to the immediate environment of the student, incorporate technology education and treat social issues of the community. The education system after 1974 generally shows the emphasis given to science education.

In Ethiopia, enquiry approach to science teaching seems to have been recognized long ago. The final report of the science commission established in January 1967 to evaluate the then curricula notes that: ...science teaching is to a large extent ineffectual if the student does not see and do things for himself science is observation and experimentation (Ministry of Education and

Fine Arts, 1967:197) cited in Mekuanent, 1992). He also shows that this same commission had also identified the faults of science teaching at that time and recommended for its improvement.

2.4.3. Science Education in Ethiopia-Post 1991 context

May 1991 was when a change of government had taken place (The replacement of military government by the transitional government). Education was one of the areas of reform focuses of the change. Two major policy guidelines were in place: a) a policy guideline produced based on the charter adopted by the conference for place and democracy' in 1991, and b) the education and training policy adopted in 1994 (Wube, 2005:67-68). Among the major problems the policy was aimed at to address are (i) the irrelevance of the previous curriculum with clearly defined objectives (ii) the high emphasis given for theoretical knowledge with little connection to day-to-day life (iii) the domination of rote learning (v) de-emphasizing problem-solving (vi) over crowding of schools (vii) the scarcity of instructional materials (viii) the high emphasis given to centralization of education system (ix) ignoring the issue of relevance, quality ,accessibility and equity (MOE, 1994). To alleviate these problems the Ethiopian government has made some major changes and exerted on-going efforts. The policy consists of general and specific objectives with special areas of priority. Concerning science education, the policy emphasis the development of problem-solving capacity and acquisition of scientific knowledge.

The teaching and learning of science in lower secondary schools (grade 7 and 8) which was given as integrated form, become physics, biology and chemistry subjects, that is separate disciplines.

The policy intends to make science teaching and learning to be based on problem-solving approach in a way that the students can acquire the problem solving skills and scientific methods and appraisal to solve their personal and society problems. The policy changed the structure of education from 6-2-4 to 8-4 (eight years of primary schooling and four years of secondary education). The eight years primary education is divided into two cycles – basic education grades 1-4 as the first cycle and general education grade 5-8 as second cycle primary education. Though the aims of science education are not explicitly stated in the policy document, it contextually emphasizes science education through focusing on the acquisition of scientific knowledge, and working towards problem – solving.

According to the policy, science education starts from the primary level and the separate subject approach in science begins at grade 7 and continue through secondary level of education. Therefore, biology starts to be offered as one component of pure science at grade 7 and continues into the subsequent grade levels. (MOE, 1994).

The policy document did not state the objectives of school subjects specifically, i.e. there is no definite purpose assigned to the different subjects of different levels of education. However, some selected physics and biology teaches and curriculum developers from some regions of Ethiopia identified the purpose of biology in grade 7 and 8 (Akalewold, 2001). Thus the suggested objectives of biology education include: (1) to develop basic knowledge, skills and attitude as which are relevant to the students life (2) to keep students know their environment (3) to solve some basic problems in their environment (4) to make the student aware of the science development and enable them to use the knowledge in regard to health, agriculture and home science.

Accordingly, the contents and methods of biology education stated in grade 7 and 8 reflect the practical work teaching approaches or learning by doing. Biology textbooks for grade 7 and 8 also incorporate different modes of practical methods such as projects, experimentations, observations, field visit experience to be carried out inside and out of classrooms. The availability of microscopes, slides, specimens and other equipments and material are also demanding (SNNPREB, 2004).

Chapter Three

3. Methodology and Research Design

3.1 Methods of the study

As mentioned in the introduction, the aim of this study was to determine the status of practical work implementation in biology in grade seven and eight primary schools of some selected woredas in Bench-Maji zone of SNNPR. For this purpose a descriptive survey method was designed to be used as a method of the research.

It was intended with the assumption that it could help to get a description of current state of the problem by examining and describing the extent and the major problems in relation to grades seven and eight biology. The method has been proved to be appropriate for such kind of studies in education (Borg and Gall, 1979; Cohen et al, 1980).

3.2 Data Source Sampling Techniques and Sample Population

For this research all grade seven and eight biology teachers, representatives of the students from grades seven and eight, school administrators and biology department heads of the selected schools of the sample woredas were included

The research was undertaken in one of the remote Zones of SNNPR namely Bench-Maji zone in the south-west of the region. In the zone there are 34 primary second cycle schools in nine woredas and one Town Administration.

For the study three woredas, and one town administration namely Bench, Sheko, Guraferda and Mizan Town administration were identified as woredas with accessibility /accessible woredas/ using purposive sampling techniques in consultation with the Zone Education Office. In the selected woredas there are twenty one primary second cycle schools.

From these woredas, eight schools were selected using quota sampling/ non random proportional stratified sampling procedure on the basis of number of upper primary schools in each woreda. The distribution of the schools among these woredas fallows the number of primary second cycle schools of each woredas. Accordingly, four schools from Bench, two from Sheko, one from Guraferda, and one from Mizan Town administration were included.

Table 1—List of Selected Schools, Number of Students, Teachers Sample Size by School Grade Level, Sex and Average Number Students Perclass.

Sample schools	No. of students by grade			Sample size by grade			Sample size by sex		No. of biology teacher	Ave. no. of Students per class	
	7	8	Total	7	8	Total	M	F		7th	8th
Genja	271	202	473	24	17	51	28	13	5	78	86
Temenja yazhe	264	136	300	22	11	33	25	8	3	56	93
Bebeka	241	364	605	20	31	51	29	22	5	81	93
Gacheb	143	156	299	12	13	25	17	8	5	88	90
Mizan no. 1	447	336	783	37	28	65	30	35	6	90	90
Biftu	71	90	161	6	8	14	9	5	2	71	86
Sheko	187	208	395	15	17	32	18	14	3	85	71
Gaizika	40	38	78	3	3	6	5	1	2	90	64
	1664	1530	3194	139	128	267	161	106	31	-	-

Since they are limited in number the school administrators, biology teachers, and head of biology department were included in the study using purposive available sampling techniques. A stratified random sampling technique was used for selecting students' representatives for the study. In order to get stratified sample students were classified by grade levels because their educational background might not contribute equally to the study.

Thus, one hundred thirty nine students from 1664 grade seven and one hundred twenty eight students from 1530 grade eight were randomly selected using proportional allocation technique for each grade level and school as well. For selecting representative from students with interval of twelve according to the list or roll number from each section, which means two hundred sixty seven (161 males and 106 females) representatives was chosen from 3194 students.

Table.2 Background Information of the Teacher.

No.	Item	Teacher respondents	
1	Sex	No of respondents	%
	✓ Male	28	90.3
	✓ Female	3	9.7
	Total	31	100
2	Educational qualification		
	✓ Certificate	-	-
	✓ Diploma	31	100%
	✓ Other	-	-
	Total	31	100
3	Service in teaching biology (in year)		
	• 1-5	4	12.9
	• 6-10	19	61.3
	• 11-15	6	19.4
	• 16-20	1	3.2
	> 20	1	3.2
	Total	31	100
4	No. of periods per week		
	< 14	-	-
	15 - 18	4	12.9
	19 - 21	5	16.1
	22 - 24	20	64.5
	25 - 27	2	6.5
	> 28	-	-
		31	100

To validate the data three school administrators and three biology department heads from three schools were included for discussion and interview using purposive sampling techniques for one school because it has laboratory rooms. The other two schools were selected using simple random sampling techniques.

3.3. Tools for Data Collection

Three data collection instruments were supposed to be used were namely questionnaire, interview, and observation. Questionnaires both open and close ended items that cover a wide range of themes were designed and administrated students and biology teachers. In the attempt to increase the reliability of the data interviews were conducted with three department heads and three school administrators.

Observation checklist was employed to gather necessary data concerning factors such as laboratory equipments and facilities. The instruments were prepared based on the objectives of the study and the literature.

3.3.1. Questionnaire

Student's questionnaire had closed-ended and open – ended and consists of 14 items. The contents basically aimed at the student's reaction to practical works in learning biology. These are items related to student use of practical activities, existing practice and kinds of practical activities, attitude and interest, availability of laboratory rooms, laboratory materials and equipments, factors impeding practical work implementation and suggestion on improving (See Appendix A- for the complete version)

Teacher's questionnaire also consists of 24 items and essentially focused on similar ideas to the students' questionnaire. The extent that teachers use of PW methods, teacher's role during practical activities, the actual practice and constraints in PW teaching methods. Furthermore, suggestions on improving practical work implementation were included in an open-ended form.

3. 3.2.Interview

For this study, basic structured individual interview questions consisting of nine items was prepared and conducted at school level to three biology department head teachers and three school administrators. The summary of their responses have incorporated in the study.
(For Interview questions see Appendix-C)

3. 3.3 Observation Checklists

For the study, observation checklists was prepared to find out the availability of laboratory rooms, laboratory materials and equipments, and school facilities such as water and electricity services. It consists of 50 items prepared in accordance with the curriculum demand of both grades 7 and 8 teaching materials and other pertinent school facilities to investigate the extent of implementation and recognition of the practical work method approach, constraints and generally the actual performance of practical activities in teaching biology.
(See Appendix- D for complete version of the observation check lists)

3.4. Pilot Test

The draft of questionnaire was prepared and distributed to students and teachers in Edget Behibret primary second cycle school in Mizan Town Administration of the Zone. Hence, minor corrections and modification to ambiguities were made according to the feedback collected.

3.5. Data Collection Procedures

To obtain adequate and relevant information for the study questionnaires were prepared for students and teachers (in Amharic language for student) respondents and distributed and collected. Question for discussion and interviews also were prepared and conducted to head teachers of biology departments and school administrators. Besides, observation was used to make the data more reliable using observation check lists.

As it is mentioned above, four groups of respondents were involved in this study. The first group was students. To all students in the eight primary schools questionnaire were distributed and all 267 (100%) have respond. A total of 31 biology teachers were asked and 100% have respond. The third and fourth group were three head teachers of biology departments and three school administrators (mizan number one, Gacheb and Genja primary schools) a total of six respondents were interviewed.

Observation was made into laboratory rooms by the researcher. For recording of data during observation check lists were prepared and employed.

3.6. Data Analysis and Management

To assess the extent to which practical works teaching method is implementing in biology and its constraints responses obtained through questionnaire were analyzed using different statistical techniques such as the, percentage or counts analysis methods have been employed to look in to the component of the assessment. Mostly, percentage analysis was used as statistical tool for descriptive data.

The data collected were organized and analyzed in a way appropriate to answer the research questions posed problem, the data were organized based on the status of PW implementation students and teachers problems in the implementation of PW methods.

The quantitative data analysis methods were used in the research. The data collected through closed- ended questionnaire were analyzed quantitatively. To determine the status of implementation and percentage technique was used.

Finally the data colleted using open-ended questionnaire and interview were analyzed quantitatively for both teachers and students head of biology department and school administrators.

Chapter Four

4. Data Analysis and Discussion

This session of the study deals with the analysis and interpretation of the data gathered. The analysis and discussion of the result is made on the basis of the items which focus on the general importance of practical work in science, biology in particular, frequency of student's use of PW, types of practical works, role of teacher's attitude and interest and factors influencing PW teaching. The items were presented to find out the existing practice and current status of PW implementation and factors inhibiting the use of practical activities.

4.1. Significance of Practical Work

The analysis of importance of PW was done in order to determine, as it was for questions, the extent to which both the student of biology and biology teachers becomes aware of the doing science in order to gain the maximum benefit of biological knowledge than any other approach. However, not all types of practical activities are equally important in helping students grasp the desired of the lesson.

Accordingly, two items, basically of the similar content to compare support and each other towards the truth, were posed to both teachers and students. The first item analyzed in Table 3, was intended to investigate the degree to which they are aware of the importance of PW teaching method and the extent to which the practical exercises they have done helped them to grasp or gain biological knowledge. The second item analyzed in Table 4, was asked to find the extent of their believes in the Importance of PW method and their feelings in doing the activities.

Teachers and students were asked about the importance of PW. Accordingly, as can be seen from Table 3, all teachers 100% (31) and 80.1% (214) students have reported that practical work is important in teaching learning of biology. On the other hand, few students 1.9% (5) and 8.6 %(23) have respectively said that they do not like it and do not believe in its importance.

In item 2 Table 4, similarly all teachers (100%) and 82.4% (220) of students have also reported that practical work is vital in teaching learning biology. Here, very few 5.6% (15) and 11.9% (32) students respectively respond that PW method is less vital and do not know whether it is important or not.

Table 3 Students and Teachers Opinion on PW

Item	Alternatives	Student		Teacher	
		No. of respondents	%	No. of respondents	%
To what extent do you believe that practical work method helped you in gaining biological knowledge?	a. To a very great extent	163	61	30	96.8
	b. To a great extent	51	19.1	1	3.2
	c. To a limited extent	52	9.4	-	-
	d. I don't like it	5	1.9	-	-
	e. I don't believe	23	8.6	-	-
	Total	267	100	31	100

Thus, the result shows that, the majority of students and all the teachers believe and claim that practical work teaching method is important to obtain biological knowledge. Similarly, the findings in this session shows that, all the sample teachers believe that practical work is an essential way of teaching biology. However, it is not enough to have the recognition of importance of practical work teaching methods, although that is of course important, the attempt should also be made in implementing it in to practice.

Researchers in the field also observed that, science teachers recognized the importance of practical work. They believed that students should have first hand experience in laboratory work in order to acquire skills in handling apparatus to measure and illustrate concepts and principles. Unfortunately, practical work did not go further than this and few opportunities were provided for students to conduct challenging investigations (Parkinson, 1994).

Table 4 Students and Teachers believes on the vitality of Practical work

Item	Alternatives	Student		Teacher	
		No. of respondents	%	No. of respondents	%
What is your opinion about the importance of laboratory method in teaching-learning biology?	a. very vital	178	66.7	24	78.6
	b. vital	42	15.7	7	21.4
	c. less vital	15	5.6	-	-
	d. I do not know	32	11.9	-	
		267	100	31	100

As pointed out in chapter two, PW activities potentially represent an interesting and effective strategy for achieving the objectives desired. Even though teaching is a major way of acquiring knowledge, class room teaching alone does not include all the different achievement required.

Several scholars in the field and teachers believed and recognized the importance of PW in science education. Gitomer and Duschl (1998) have said that.

> *... an educational program that partitions the teaching and learning of content from the teaching and learning of process will be ineffective in helping students to develop scientific reasoning and an understanding of scientific knowledge.*

School science, particularly, biology is essentially a practical activity, with a long tradition of pupils experimental in the school. In short doing practical work provides a reaffirmation of the vital importance of practical activities, centered on problem solving approaches.

4.2 Magnitude of use of practical work in the School

Literatures show a number of reasons for carrying out PW in science lessons. In learning biology pupils need to have the opportunity to find and discover relationship among facts, materials and events and to come up with their own generalizations. To investigate the extent of happening, students and teachers were asked about the magnitude of doing PW method in biology lesson.

Table 5 Frequency of student's use of practical work

Item	Alternatives	Student		Teacher	
		No. of respondents	%	No. of respondents	%
Extent of use doing practical work	a. Always	24	9	-	-
	b. In most case	51	19.1	-	-
	c. Only sometimes	34	12.7	31	100
	d. not at all	158	59.2	-	-
	Total	267	100	31	100

As it can be seen from Table 4, 59.2% (158) of students have reported that, teachers have not engaged them in doing practical works at all. Others 12.7% (34) of them have said that they practice it only sometimes.

Like students, teachers were asked about the frequency and type of practical activity they did so far. Accordingly, For the same item all teachers (100%) have replied that, they engage their students in doing practical works only some times.

Similarly, 87.1% (27) teachers have also reported that, they use teacher's demonstration in most cases; they never use individual, pair of small group of student's practical activities. The implication is that teachers employ other type of practical activities rather than using the very effective approaches such as individual or small group activities. Similarly for the interview question posed about the extent to which biology teachers engage students in laboratory work, head of departments and school administrator, it was to a very limited extent have respond that teachers use lecturing and few demonstrations in teaching biology due to one or another reasons. There are no laboratory rooms and necessary lab materials and conducive school facilities for conducting laboratory works.

In this regard teachers (C and D) have said that in the absence of laboratory rooms and necessary materials we can not expect practical work teaching from teachers, as they are also biology teachers. One teacher (Teacher F) particularly said that:

> *"as it can be seen, there is no laboratory and the necessary materials...*
> *the frequency of implementation is very limited briefly."*

The observation checklists conducted to schools about the records of activities performed any and inventory of the activities done also asserted this fact. Besides the observation findings also show the absence of the necessary materials. There is no pot plant grown , (for instance ferns and lichens) as have stated in the biology students text books.

One head teacher (Teacher, E) has also stated that *"some teachers themselves seem reluctant to implement practical works".*

This implies that the absence of the required resources and lack of conducive school environments de-motivated teachers towards the activities as this was also realized from the observation results.

In other words, what counts as a result here is the magnitude or frequency of student's use of practical work method in biology is very limited. The issue practical work as discussed by many scholars, has a distinct advantage of enabling students to work directly with materials and phenomena in the students biological and physical environment. It is claimed that different types of scientific knowledge require different teaching strategies for intended learning out comes to be achieved. In biology educators typically place great importance on practical work method of teaching. Because when students have exposure to the real-life situation they would understand the role of the lesson in their local society With regard to this, Arzi (1998) suggest that:

> ***...thinking in science is of associated with creativity and problem solving. The experiences in science are only possible through implementing various practical work methods purposefully and if students are provided with the opportunity to be involved in the necessary experiences in science ... but not merely reading about of science.***

In other words, many efforts should be made expected towards implementing PW remain strongly influenced by traditional practical work teaching methods that have laid the greater emphasis on the recall of knowledge and understanding of contents.

According to several scholars, the purpose of PW is to help students acquire scientific competence and know when and how to use science in a positive way. Parkinson (1994) confirms this by saying that:

> *...Knowing about science is important, but being able to do science; to act scientifically, to apply scientific knowledge, understanding and skills in individual and collective situation is more important ... this involves exploring in action through the acquisition and application of skills and knowledge of scientific inquiry, capability and testing of ideas.*

Similarly, Hegarty (1990) also describes that ... one possible strategy for enhancing student learning and memory of scientific knowledge is by active involvement rather than watching a teacher demonstration.

There fore, biology must depend up on the possibility of dealing with certain, at least compulsory practical activities, as there is a wealth of materials to use in the subject. This led to

many different desirable out comes such as understanding and familiarity with techniques and apparatus.

4.3 Types of Practical Activities Used

As suggested by several researchers, the realization of the students learning in biology depends largely on the careful matching of the practical activities to the different objectives of the subjects. That is why because different kinds of practical activities potentially represent an interesting and effective strategy for achieving the goals. As pointed out in chapter two, PW experiences play a significant role in helping students acquire skills or develop the various scientific inquiry skills. The student of biology becomes aware of the various approaches and process involved in biological investigations by conducting purposeful practical activities. As to Brown(1995) a lesson plan for teaching biology should contain the skills to be required, the significant process involved and interactions wished, the kinds of reports (oral or in writing) the students are expected to produce, suitable assessment techniques and similar points must be considered. Barr (1994) also claims that opportunities should be provided for small group of children to work together.

To investigate the types of activities used towards the accomplishment of the PW methods and kinds (observational or experiment) the various approaches to be used for the activities stated in the biology text books, questions were posed to both teachers and students. Accordingly, items consisting of various types of activities were presented to respondents in such a way that the extent of use could be explored.

As it can be seen from Table 6, 82.4% (220) students have reported that, they often use listening to lecture and demonstration by teachers. Similarly, when we go across the activities through Table 6, the majority of students (67.4%, 63.7%, 75.6%, 76.8% and 81.7%) in accordance to activities (activity 2,3,4,5 and 6) respectively have reported that, they have been engaged in one or other practical activities either some times or not at all.

On the other hand, some students (33.3%, 36.3%, 25%, 23.2%, 17.6%) respectively have responded for these activities, that they often have been engaged in one or other practical activities.

The student's response to this item, generally, implies that the kinds of practical activities to be used in these grades levels were limited to demonstration and lecture by teacher. The other many types of activities such as individual and small group practical activities were not employed.

Table 6 The way students carry out practical activities.

	Students' respondents in accordance with keys to alternatives							
	Very often		**Quite Often**		**Seldom**		**Never**	
	No. of respon.	**%**	**No. of respon.**	**%**	**No. of respon**	**%**	**No. of respon.**	**%**
1. Listening to the teachers demonstration, explanation and summaries	168	52.9	52	19.5	31	11.6	16	5.9
2. Doing practical activities individually	25	9.4	62	23.9	145	54.3	35	13.1
3. Doing practical activities in group of 3-5 students	28	10.5	69	25.8	142	53.2	28	10.5
4.Doing practical activities in pair.	28	10.5	36	13.5	90	33.7	112	41.9
5.Having to write reports and notes on the activities	22	10.5	40	15	80	30	125	46.8
6. Observing whenever other doing experiments.	11	8.2	35	13.1	84	31.5	134	50.2

Literatures show that, though much more important is the question of whether the pupils are actively engaged in their learning, it is well to remember a wide range of teaching methods and resources, of which small group practical work is one option. Brown in support of this have said that

"most practical activities in science involve pupils working in group size of two or three" (Brown, 1995: 21-34)

In other words the features observed in this study shows that practical work teaching method have given less emphasis and students are not encouraged to carry out the different kinds of practical activities. What is actually taking place and surveyed in the present class room /school situation is contrary to what is written in teaching material of the target grades levels. There is no doubt about it, PW is an essential and used in variety of ways to enable pupils to learn more about science. Similarly, Romey (1968) also said that

'...the effective science course should be practical oriented rather than text or lecture centered. This is to mean that more emphasis should be given to practical work methods than talk ad chalk".

In Table 7, 87.1% (27) teachers have replied that they employ lecture and demonstration only sometimes. In other words, as it can be been from the same table item 2,3,4, teacher's seldom use the kinds of practical activities posed. For example (48.4) of teachers reported that they never use individual PWs. Where as 77,4% and 54.8% have replied that they seldom employ pair and group of 3-5 students' activities. What this implies is that teacher use verbal presentation of the contents and facts stated in the text books in most cases.

In this sense, the teaching of biology in our primary school was found to be subject matter centered, although the biology teaching material or curriculum claimed to follow and emphasis the practical work teaching strategies.

Although such activities-demonstration and lecture by teacher are better than none, they are not as effective as allowing the student to pass through the process involved with conscious knowledge.

In Table 7, when teachers responds are analysed across the activities through the Table, almost all teachers (87.1%, 83.8%, 90.3% and 87.1%) respectively replied to each activities that, they employ one other practical activities either sometimes or not at all.

Table 7 Teacher's opinion on the type of activities they use in teaching biology.

Item	Teachers' respondents in accordance to alternatives							
	Very often		Quite Often		Seldom		Never	
	No. of respon.	%	No. of respon.	%	No. of respon.	%	No. of respon.	%
1. Teachers demonstration while students are observing.	2	6.5	2	6.5	27	87.1	-	-
2. Individual student activities.	-	-	6	19.4	11	35.4	15	48.4
3. Pair student activities.	2	6.5	1	3.2	24	77.4	4	12.9
4. Group of 3-5 student practical activities.	3	6.7	1	3.2	17	54.8	10	32.3

Biology teaching offers substantial emphasis to inquiry learning. The method and techniques which are compatible with the discipline must be emphasized. Thus teaching and learning biology in the absence of practical work method and use of real specimen would not bring the desired biological knowledge. (Brown, 1995).

As stated in chapter one, the major objective of the practical work use as the basis of this study is to enable the student understand the process of biological enquiry so that a true understanding of the subject could be achieved. In this sense, the biology text book for grade 7 and 8 aims to enable students take active participation in solving personal and social problems. The majority of teachers surveyed responded that they scarcely use the practical work teaching. In other words verbal presentation of facts and few demonstrations by teacher dominates the teaching of biology in the upper primary schools surveyed in this study.

As described above, if every day biology lesson and classroom perspectives do not explicitly foster students thinking of scientific methods and doing science, it is clear that there is always a mismatch between what the biological science curriculum wants for student and what the school does for students.

4.4. Role of Teacher, and Assessment of Student's Mastery of Practical Work

As to several scholars, to make the maximum use of the practical work teachers are expected to run and facilitate many of the efforts. Gallagher and Tobin, 1987 in Tamir and Lazarowitz. (1994:117) have said that.

> *"...Among the teacher important role is the facilitative learning by maintaining an environment in which students receive challenges and assistance as required."*

Parkinson (1994) also stresses that, becoming a good science teacher is not just a matter of mastering a few survival skills ... but an on-going process where practice is constantly reviewed and new, more effective techniques used. Eventually, the extent to which a given science environment in effect and enhance education depends on the teachers subject – matter knowledge, pedagogical knowledge, believes and genius to the use of the available resources, more than on the particular physical features of any facility. In this regard Lunetta (1998) suggested that ...

> *...the teacher has many challenging roles to pay in engaging students in appropriate practical activities, in serving as a co-inquirer who models appropriate problem solving in facilitating discussion of scientific practical concepts and theories, in sensitively sharing strategies and explanations ... engaging students in relevant concept building discussions.*

The analysis of teachers role and assessment technique was basically to find the degree to which they serve the purpose for which they are responsible in helping students grasp the process involved in scientific method. Accordingly, teachers were asked about their role and the assessment techniques they use in practical work teaching methods and so that to imagine the degree to which they have used the feed back obtained contributes for the implementation of types of practical activities.

Their responds about their role when ever students carry out practical activities were as can be seen from Table 8, all teachers (100%) have reported that the role of the teacher to be facilitating and encouraging students in practicing. Here as they were asked to respond to the

question in such a way that they can rank for more than one alternatives, almost half (54.8%) of teacher have reported there activity to be discussion with them.

The result indicates that; teacher's role is facilitating, encouraging students in practicing. On the other hand in Table 6, they have reported that they use demonstration method while students are observing. This implies that despite knowing their role, they did not work towards the implementation. How ever by making the work interesting through a variety of approaches and patterns of working the teacher has to enable his/her pupils to reach the frontiers of the field, and increase the percentage of PW implementation and the extent to which students do experiments individually and in pair or small groups. Probably the above problem implication is that there are other factors influencing teachers to work towards the activity. That is other existing problem related to biology teaching aggravated the in effectiveness. As discussed in Temechegn (2001:71) researches also emphasized that teacher unfamiliarity with the method was one factor for the prevailing weakness. So improvement in the other problems specific to the teaching of the biology is subject to changes in problems that affect the whole education.

Table 8, Teachers Opinion on Their Role.

Item	Alternatives	Teachers	
		No. of respon.	%
What do you think the role of the teacher whoever students carry out practical activities?	a. Correcting errors on the spot	-	-
	b. Facilitating, encouraging in practicing	31	100
	c. Discussing with them	17	54.8

Teachers were also asked about the technique they use for the assessment of student's mastery of practical activities. A number of researchers here suggested that perhaps the most important issue is the clear definition of the purpose of assessment-to improve instructional practice and student learning. Tamir (1998:785) describes that.

> *...It can be asserted that the most important single factor influencing the achievement of student is authentic assessment. Evaluation always has represented an important corner stone of education.*

He also added that, certainly, educator's posses a basic need of knowing whether their educational intentions are realized, to what extent their activities achieved their goals, how best to plan for continues optimal instruction. In support of this Gitomer and Dusch (1998) also shows that, a critical issue for improving practice concerns the role of assessment.

Table 9 Teachers' Response Regarding Assessment Techniques of Mastery of Practical Works.

Item	Alternatives	Teachers	
		No. of respon.	%
What method do you commonly use to assess students' mastery of practical works?	a. Observation	1	3.2
	b. Written tests	31	100
	c. Actual practical activities	-	-

As this item wast to investigate the assessment technique teachers commonly use in biology lesson questions was posed only to teachers, as shown in Table 9 all of them 100% have reported that, they use written test items as the only techniques to evaluate their student's mastery of practical works. While the majority of teachers have reported they that use demonstration method for which the learner is passive listeners, teachers believe or know that the assessment technique should be relevant. As they have given the chance of ranking for more than one alteratives one teacher, additionally suggested that he uses observation as a technique of assessment.

4.5. Attitude and Interests of Both Teachers and Students

As pointed out in the literature, a number of scholars found out the importance of attitudes and interests towards practical work. For instance, Hodoson (1993) confirm that practical work occurs as a result of attitudes and interest of both teachers and students towards the activity by saying that:

> *...While many students enjoy practical works and develop positive attitudes to it, their are many who do not, and some others also expresses a 'dislike' for practical work.*

Attitude and interests of both teachers and students towards PW methods i.e. weather or not they were enthuse in doing biology' two questions were posed to both teachers and students as they have implication on its in effectiveness. Basically, both items used seems but as it was

intended to explore the extent to which they are interested and what they feel in doing the activities, as this was helped to cross check and imagine beyond their responses, to reach up on the reality. Accordingly, their responds were analyzed in Table 10 and 11 presented below.

Table 10 Students and Teachers Feeling in doing Practical Work

Item	Alternatives	Students		Teachers	
		No. of respon.	%	No. of respon.	%
What do you feel when you participate in practical work activities in biology.	a. very interested	160	59.9	21	67.7
	b. interested	52	19.5	10	32.3
	c. less interested	11	4.1	-	-
	d. not interested at all	2	0.75	-	-
	e. indifferent	6	2.2	-	-
	f. need to get help of others	36	13.5	-	-
	Total	267	100	31	100

As it can be seen from Table 10 the majority of respondents 79.4% (212) students and all teachers replied that they are interested in practical work doing. On the other hand, 2.9% have reported that they feel indifferent or not interested at all.

Table 11 Students and Teachers, Response to their Feeling in Doing Practical Work

Item	Alternatives	Students		Teachers	
		No. of respon.	%	No. of respon.	%
To what extent do you enjoy practical work teaching learning.	a. To very great extent	181	67.8	22	70.9
	b. To a great extent	52	19.5	9	29.1
	c. To a limited extent	26	9.7	-	-
	d. Indifferent	5	1.9	-	-
	e. I do not like it all	3	1.1	-	-
		267	100	31	100

As it can be seen from Table 11 both teachers (100%) and students 87.3% (233) have asserted that they enjoy practical work to a great extent. For this item very few students 1.9% (5) and 1.1% (3) have also respectively replied, that they feel indifferent and they dislike doing practical work methods at all. What the above discussion mean is that, the majority of both

students and all teachers have positive attitude and interest towards practical activities. Given that teachers attach a higher degree of importance to practical work and they also have a positive attitude to it, where as they use PW in a very limited or poor extent.

4.6. Factors Affecting Practical Work Implementation

A number of researchers in science education found out several factors affecting practical work teaching in school science. As pointed out in the review parts, lack of laboratory rooms and lab equipments, school facilities and resources, curricula, large class size, shortage of time, attitude and interest towards practical activity, teaching methodology are some to be mentioned. Research in the field informs that:

> *...laboratory equipments, chemicals, specimens in accordance with the curriculum demands are part of the essentials to fulfill the specific objectives of each portion in the course (MOE, 1996).*

In order to investigate major factors influencing PW implementation in teaching biology, questions regarding time, budget, laboratory rooms, equipments and school facilities, and other related factors were posed to both teachers and students. The results will be present in Table below.

4.6.1. Time Allocation

Literatures show that both teachers and students require adequate time. Some time teachers may not have time to collect all the necessary materials and set up an apparatus for an experiment or demonstration. As a result many teachers are ill-prepared. In ardor to investigate the feasibility of time required to complete each activity in relation to the amount of time allotted for biology in each grade level teachers and students were asked about the adequacy of time. In considering adequacy of time, it was judged in relation to the procedures used to conduct the activities- (observation, teacher demonstration and experimentation). Accordingly the fallowing result was reached up on:

Table. 12 Students and Teachers, Responses on Time Allowed For Practical Works.

Item	Alternatives	Students		Teachers	
		No. of respon.	%	No. of respon.	%
What is your opinion of Time allowed for practical work activities in text book biology?	a. Very adequate	45	16.9	-	-
	b. Adequate	15	5.6	-	-
	c. Inadequate	22	8.2	3	9.7
	d. No time regular scheduled for practical activity	183	68.5	28	90.3
	Total	267	100	31	100

As it can be seen from Table 12, the majority 68.5% (183) students and 90.0% (28) teachers have replied that there is no time regular scheduled for practical works in teaching biology. Similarly, few students 8.2% (22) and teachers 9.7 %(3) have respond that the time allotted is inadequate., What counts as a result here is there is no adequate time allotted for practical activities.

Interview results conducted to head teachers of departments and schools administrators also have reported this truth. No school allows particular time schedule for practical activities.

4.6.2. Budget Allocation

This question is posed to teachers, head teachers and school administrators as they are more aware about the issue. Thus, as it can be seen from Table 13,96.8%(30) teachers have reported that, no school allocate budget for purchasing laboratory materials.

In the interview questions, all the respondents witnessed that budget allocation for purchasing laboratory materials and equipments is not a familiar process in their schools. This is to mean that all the schools do no allocate budget for purchasing lab materials required for conducting practical activities stated in biology text books.

Table 13 Teachers' Response to the Allocation of Budget for Purchasing Lab Materials.

Item	Alternatives	Teachers	
		No. of respon.	%
Does school allocate budget for purchasing of materials necessary for implementing practical activities stated in biology text book?	a. Yes	1	3.2
	b. No	30	96.8
		31	100

4.6.3. Availability of Laboratory Materials

The data extracted from interview conducted to head teachers of the departments under study and school administrators shows the absence of the resources – laboratory rooms, equipments and their facilities. When teachers were asked the question: Do you think that your biology laboratory is well equipped? there responds were found to be the same. In this sense their response lies on the idea that, they have no laboratory rooms and equipments as well. In this regard one teacher (teacher, B) in particular rose why he asked about the questions such as about the extent to which laboratory rooms are equipped, knowing the absence of the necessary things. He said briefly expressing his feelings that: "*we have nothing.*" Other teachers commonly reported and agree up on that their schools lack both the laboratory and the necessary materials.

The observation check lists made in to the availability of materials and equipments in accordance the curriculum demand, as can be seen from Appendix D, indicates the reality. With no doubt about it, in the absence of laboratory room or at least science room to accommodate all the pure science subjects expecting laboratory work may be unthinkable. Of course, there are a number of practical activities could be done stated in the biology student text books despite the limitation putting in to practice.

Teachers and students were asked about the availability of lab materials and equipments for doing practical activities stated in student's biology text books. Accordingly, 70% (187) students and 96.8%(30) teachers have reported that there is no materials and equipment at all. Others 15.7% (42) and 3.2% (1) teacher have said that, it is equipped to a limited extent.

Table 14 Students' and Teachers' Response on the Availability of Laboratory Materials and Equipment

Item	Alternatives	Students		Teachers	
		No. of respon.	%	No. of respon.	%
Do you think that biology laboratory is well equipped for doing practical activities stated in biology text book	a. To a very great extent	20	7.5	-	-
	b. To a great extent	18	6.7	-	-
	c. To a limited extent	42	15.7	1	3.2
	d. Not at all	187	70	30	96.8
		267	100	31	100

As this can be seen from the discussion of interview results all the respondents have replied that there is no materials and equipments.

The findings of the observation also shows that, the sampled schools lack laboratory rooms, except the one which is functionless, they all lock important lab materials, equipments and chemicals required for teaching practical activities in the subject under the study. For instance, as can be seen from Appendix-D, some of the major materials and chemicals required by the curriculum grade 7 and 8 biology students text books but lacking are as follows.

So from the above data and the discussions one can imagine the impact of the problem on to the implementation of PW teaching method. Regarding this Barr (1994) found out that...

> *..class room environment that provide opportunities for small groups of children to work together to solve problems tend to foster the development of problem solving.*

Table 15 Teachers' Opinion on the School Facilities, Equipments, Chemicals and Resources Availability.

Item	Alternatives	Teachers	
		No. of respon.	%
Are there sufficient school facilities, equipments, chemicals and other similar resource available for the practical activities stated in biology text book?	a. Yes there are	-	-
	b. No there are not	2	6.5
	c. Only for few exercises	7	22.6
	d. Not at all	22	70.9
	Total	31	100

As it can be seen from the above Table, 70.9% (22) teachers have reported that, there is no sufficient school facilities, equipments, chemicals and other similar resources available for conducting practical activities stated in biology text books. On the other hand 29 % (9) teachers have replied that only available for few exercises.

In general, the sample schools lack the necessary conditions for implementing practical activities. On the other hand, the observation checklists conducted in to the selected schools, as can be seen from Appendix D, shows the absence of all the required materials in accordance to the curriculum demands. This implies that no effort was done towards the situation.

Needless to say that there was no laboratory materials, equipments or no specimens of organisms collected were seen; as the findings of the observation also indicated. Only few charts and diagrams were observed in the school pedagogical center.

Teachers were also asked about the issue to investigate their opinion on the source of lab materials and equipments. Accordingly, as it can be seen from Table 16, 58.1% (18) teachers have replied that the materials are obtained from the organizations like the Ministry Of Education. Other teachers (48.4%) said that, the materials are obtained locally with no or low cost by both teachers and students.

Table 16 Teachers Opinion on the Source of Lab Materials and Equipments.

Item	Alternatives	Teachers	
		No. of respon.	%
Where do you think expect that the materials and equipments obtained for exercises in biology text book	a. Collected and prepared by teachers	2	6.5
	b. Collected and prepared by students	-	-
	c. Locally with no or low cost by both teachers and students	15	48.4
	d. Obtained from organization like MOE	18	58.1

Scholars such as Brown (1995) with this regard states that ... *becoming a teacher of biology depends to a considerable extent on being able to call up on the knowing of what resources to use for the lesson and how to get this sort of materials being a resource bank of*

ideas for lesson content. The resources teachers need for their lesson are teachers own responsibility.

In the observation check lists conducted many of the materials could be prepared at school level, for instance, plant such as fern, lichens etc. grown in pot, specimens of different organs of plants and animals were not found in the schools.

4.6.4. Summary of Factory's Influencing Practical Work Implementation

As stated in chapter one, the major objective of the PW method use as the basis of this study is to enable the student understand the biological knowledge so that a true understanding could be achieved. This is also the major objective of the biology lesson curriculum. The primary second cycle biology curricula also clearly states that the practical activities are to serve as the basis on which students understanding of concepts and principles would depend so to enable them to be literate citizen in biological science.

The practical activities stated in biology text books over all are intended to help students understand the process or biological science. With regard to this, the text could serve as a supply of problem areas of practical work methods for a teacher who uses them. How ever, their implementation has been found to the very minimal. Indeed has been said by Mekunent (1992) the immense distance between real (actual) and mythical pedagogy could hardly be better illustrated. Although biology curriculum emphasizes the teaching of biology to be practical oriented, its teaching was found to be move of the theoretical and content oriented.

As it can be seen from Table17 above, teachers and students were also asked to point out factors that they think hampering practical work teaching in their schools accordingly, 84.6%(226) student and 100% teachers agreed on the lack of lab materials equipments, chemicals and schools facilities to affect practical activities here the respondents were given the chance to respond to more than alter natives by tanking from the most ranked (1) to the least (9).

Significant numbers of respondents 71.2% students and 64.5% teachers have reported lack of laboratory rooms as the second major factor. In general the data treated under this section show that a number of factors inhibiting PW in teaching biology of which lack of laboratory rooms, lack of lab materials, equipments and chemicals are the major reasons for the weakness

of the activity. The sample schools are in serious problems to the extend being unable to help even teacher's demonstration.

Be sides, 51.8% of students and 48.4% teachers have also reported that, large number of students in the class room affects PW teaching. As to teachers response, large class size and shortage of time equally contribute for the weakness of practical activities implementation in biology as the second reason. As can be seen from Table 1, the average number of students per class is 80 students at grade 7 and 84 students in grade 8. On average teachers have more than 24 periods per weak at both grades levels of the sample schools. Thus, one can imagine the large number of students and teaching load teachers encountered, which directly aggravates the challenges.

In short, as all the above discussion briefly shows, lack of laboratory room, lack of lab materials and equipments are found to be the major factor influencing the implementation of PW teaching methods in biology.

Table 17 Summary of Factors Affecting practical work implementation suggested by teachers and students.

Item	Alternatives	Students		Teachers	
		No. of respon.	%	No. of respon.	%
What factors do you think, that inhibit practical work implementation in teaching biology in your school? (mark them from the most ranked(1) to the least (9)	a. Lack of laboratory room	190	71.2	20	64.5
	b. Lack of lab materials, equipments, chemicals, school facilities such as electricity, water etc Situations are not conducive.	226	84.6	31	100
	c. Lack of adequate time	184	68.9	15	48.4
	d. Lack of teachers method logy of reaching	190	71.2	11	335.4
	e. Large class size	138	51.7	15	48.4
	f. Lack of teachers motivation and interest	138	51.7	2	6.5
	g. The activities are not inviting and beyond students capacity.	138	51.7	7	22.6
	h. Lack of students motivation and interest.	72	26.9	11	35.5
	i. Lack of due consideration by teachers (only for students).	129	48.3	-	-
	j. Work load and shortage of time by teachers (Only for teachers).	-	-	11	35.5

4.7. Teachers and Students Response to Open-Ended Questionnaire

In the, open-ended questionnaire the students and teachers were asked their opining on how to improve PW implementation in teaching biology. For this item all the respondents have focused on some similar basic point's i.e their answer depends on an answer to question /item answer depends on an answer to question /item 13 and 14 of both practical work implementation in their respective schools. These are summarized below.

Even though very few students have not replied to this item genuinely, the majority almost all teachers have reported that,... there must be laboratory rooms supplied with necessary facilities and equipments for instance (Teacher C,E,F) stated that ...

"building laboratory rooms and facilitating with materials"

Other significant number of students have reported assigning good biology teachers. One student respondent particularly stated that ...

"assigning good biology teacher besides solving the above problems"

This means the common problems stated under the close-ended item number13. Almost all teachers have also commonly reported that absence of laboratory, lab materials and facilities, lack of budget and large class size improvements. Few teachers also replied work shops and trainings as refreshment for teachers. One teachers (Teacher B) has stated that

"Assigning specialized laboratory assistant"

In general the extracted summary lies on the provision of laboratory equipment and materials with facilitated rooms that could be solved step by step, unless and other wise it is difficult in the present form of the sample schools.

Chapter Five

5. Summary, Conclusions and Recommendations

This part deals with the summary, the conclusions reached an and the recommendations made on the basis of the study.

5.1. Summary

The purpose of this study was to investigate the state of practical work implementation and factors that hinder its implementation in teaching-learning process of biology in upper primary schools. The study was conducted in eight selected upper primary schools (grade 7 and 8) in four woredas of Bench Maji zone in SNNPR. Specifically, the study attempt to assess the following basic questions.

1. How often do biology teachers in primary schools use PW methods in teaching biology?
2. What are the attitudes and interests of biology teachers and students towards practical activities in biology?
3 .What factors do influence teacher's use of PW methodology in teaching biology?

To accomplish the purpose of the study the following population were subjected. The first group consisted of 267 students (139 grade 7and 128 grade 8) were randomly drawn from grade seven and eight of these schools.

The second group consisted of all biology teachers from the schools. The third and fourth group consisted of three head teachers of biology departments and three school administrators.

Data for the investigation were obtained through two types of questionnaires –one for students and the other for biology teachers. Interview items to head teachers of biology departments and school administrators and observation check lists also conducted to three schools mentioned above to observe the availability of laboratory rooms, materials and school facilities. Finally the data obtained were analyzed and the study come out with the following findings reached up on.

5.1.1. Types and Importance of Practical Work.

Almost all teachers have agreed that they seldom use individual and pair or small group experimentation procedures. Teachers honestly witnessed that leave alone individual or small group activities, even demonstration by teachers also be employed very seldom. What it means is that practical work methods or types were not practiced in the sample schools by both teachers and students adequately.

All teachers (100 %) and 80.1% students have reported that practical work is important in teaching learning biology.

However, the current teaching-learning method in biology is teacher-cantered. That is, limited to take place with teachers as the main actor and learners passive observers and listeners.

The summary of this study indicates that, our primary schools are still in the spiral of traditional practical work teaching and the dream towards problem-solving is still in serious challenges.

5.1.2. Existing Practice and Practical Work Implementation

The majority of students surveyed (59.2%) respond that teachers have not engaged them in doing practical work or lab activities in teaching biology.

Students use listening to teachers' demonstration and verbal explanation of the facts.

The findings of the study have revealed that the practical work teaching method in grade seven and eight of the sample schools, seem to have neglected, or practical activities are considered as some thing additional that could be omitted, but not as an integral part of the subject matter. Most of the time the sample teachers have tried using to a particular method of teaching like lecturing and rarely demonstration method rather than using of discovering other effective approach to each lesson as they prepare for it. Students have had limited opportunity to explore and discover.

5.1.3 Expected Role of Teacher

In this study all teacher respondents confirmed that their role in PW teaching method to be facilitating, encouraging and guiding student in practicing. This is to mean that teachers have

the notion of their responsibility despite limitation in putting it into practice. All biology teachers witnessed that, written test type was used as the only means of assessment techniques of the students' mastery of the practical works. No relevant practical assessment technique was employed, as practical activities were also not practiced.

5.1.4. Attitude and Interest

According to the results of the response replied by students and teachers they have positive attitude and interested towards biology practical activity, but to the contrary the practical activities are almost not employed. The learners have not given an opportunity to deal with practical activities in the laboratory or field works.

The majority of both students (80.1%) and teachers (100%) respond that they feel interested in doing practical activities and agreed with that they feel happy in participating or doing practical work in biology.

Although all teachers asked and interviewed believed that PW method is an effective way of teaching biology, they generally do not work toward such activities.

5.1.5 Factors Affecting Practical Work Implementation

Most of respondents have said that, there are a number of factors affecting practical work method in biology. Among these:

1. No time regularly scheduled for doing practical works in all sample schools. Large number of respondents 68.5% students and 90.3% teachers realized this factor to inhibit its implementation. Head teachers of biology departments and school directors also added that specific time allotment for practical works in science education and biology in particular was not a familiar process.
2. The schools have no budget allocated for purchasing laboratory materials and equipments required for the exercises. As it was asserted by the results of interviews and inventory of resources made, the principals of the schools and biology departments said that budget allocation for laboratory equipments and materials is not familiar practice in the school.
3. Significantly, higher percentages of respondents (84.6% students and 100% teachers) have reported general factors influencing PW implementation.

Accordingly, the majority of the respondents agreed up on two factors to be the major response for low implementation of practical activities. Therefore, lack of laboratory materials, equipments, chemicals, school facilities and services and lack of laboratory rooms as the first and second reason respectively.

Among the sample schools only one school (Mizan number one primary school) has function less laboratory room, with no necessary materials, equipments and other facilities.

Needless to say that there was no laboratory materials, equipments or no specimens of organisms collected in the observed schools; only few models charts and diagrams were observed in the school pedagogical centre. Among the key equipments, microscope and slides were not found in all the surveyed schools. The inventory and interview made have confirmed that , the schools deficiently served and lack important materials, apparatus and chemicals stated in the biology text books.

4. The findings of the study also depicts that. These include, large class size, teachers work load and shortage of time and lack of due consideration was found another major inhibitory factors. On average, teachers have more than 24.4 periods per week at grade 7and 8. The average number of students per class is 80 students at grade 7 and 84 students at grade 8. Thus, it is clear that teachers encounter large class size and teaching load.

5.2. Conclusion

The poor implementation of practical work teaching and little performance of students in science education, in particular biology continue to probe a challenge for problem solving intentions of the education system. This study has found out a number of variables play a pivotal role in hindering practical work implementation in biological science.

The finding of this study revealed that, practical work teaching method in biology is almost not employed in the sample schools. Almost all sample schools are deficiently served in terms of laboratory rooms, materials, equipments, chemicals and school facilities such as water and electricity services.

The study shows that school science, biology in particular teaching-learning techniques of the existing practices are old and lacks modern trends of teaching science. The demanding requirements of effective implementation of PW teaching methods necessary for meeting the

problem solving of the pupils in biology was found very poor. Though, PW is regarded as a key to biology teaching, the provision of educational opportunities for students, falls a short of the desired. Of course the need for awareness of the issue of PW in education is widely recognized.

On the basis of this study it can be possible to conclude that the existing status of upper primary schools biological science curricula, as examined from the practical work implementation points of view in teaching biology, is very poor. What is actually observed in present class room situation is contrary to what is intended and written, in the teaching materials. Currently, biological science education takes place in our primary schools with teachers as the main actor and students as passive observers and listeners. The desired outcomes of biological science to be obtained through laboratory work practice and the transfer of scientific methods and skills necessary for the development of problem solving of the individual was ill-treated.

Needless, to say, what was desired to bring about through exercising practical activities and what have been going on in teaching biology is far from the kinds of pedagogy suggested by the teaching material of biological science curriculum.

Thus the present primary schools classrooms are under very poor and unsuitable conditions to implement the practical work approaches fully. The sample schools lack laboratory rooms, laboratory materials ,equipments and chemicals suggested in the biology textbooks, and lack of facilities together with large class size and teachers work load and shortage of time are the major factors impeding practical work implementation. Despite substantial progress seen towards raising enrolment, the quality of primary schooling is generally low; basic learning materials are lacking.

The gap between the opportunities that laboratory work should provide for developing knowledge and the existing activities actually performed by students could be attributed to the following major interrelated reasons in the eyes of the researcher.

1. Although all teachers asked and interviewed believe that practical work method is an effective way of teaching biology, they do not work toward such activities. Rather they use the lecture method which does not seek a problem solving approach.

All kinds of practical activities stated in biology text books practically observed functionless and limited to few demonstration and lecture by teachers in all the surveyed schools. Substantially, objectives which emphasise problem solving skills, the practical work methods

and its types are not practiced by both the teachers and students in biology. So the skill to experiment, observe, examine are almost non existent.

2. The findings of this study revealed that, the practical work teaching method is put in to practice to a very limited extent in biology.

3. Most teachers and students believe that, almost all grade 7 and 8 students of the sample schools.

Teaching of biology was found to be subject matter oriented. It is also possible to conclude that. Teachers have the notion of their role and responsibility, despite putting it in to practice. The assessment technique of the students' mastery of practical activities was found to be the type of written test or paper-pencil strategies.

4. No time regularly scheduled for practical work teaching in science and biology in particular. Some times teachers may not have time to collect all the necessary materials and set up an apparatus for an experiment or demonstration. Thus teachers work load and inadequate time is another factor for the weakness of laboratory teaching.

5. Budget allocation to biology laboratory and science laboratory in general is not a familiar process in all sample schools, attributing for the weakness of PW implementation.

6. Most of the respondents have said that there are a number of factors affecting the practical work methods in biology. The over all situation of the school, that is, laboratory room, laboratory materials, chemicals and other school facilities and services are inadequate.

The schools have no laboratory rooms, lab materials, equipments, chemicals and scientific apparatus. Many schools lack water and electricity services.

5.3 Recommendation

The major reason the researcher gave attribute to the low implementation of laboratory works was the low development of practical work teaching culture of teachers and school environments, absence of laboratory materials, equipments and school facilities as the whole. Therefore, dealing with this and other problems are seems to be an urgent need. With this in mind the implementation of practical work teaching methods could take the following

suggestions. If to implement practical activities in biology in one and /or more ways, there some sort of improvements in the schools conditions will be necessary.

1. Teachers should plan to deliver biology lessons where students are actively involved in obtaining information. Being aware of the various problems which could only be solved step by step in the process of development teaches have to put much effort and d be creative enough to effectively use the resources in hand. There is no doubt about it ,practical work teaching is an essential and central element of teaching biology ....profound content can be lost, in fact negated, if the methods of teaching are haphazard and at variance with the nature of the content(Anderson,1972). Therefore teachers should aim to provide lessons that are practical-cantered rather than text or lecture cantered (Brown, 1995; Dallas, 1980; Gleen, 1965).

Researchers in the field stress that if the teaching of biology is to make its maximum contribution to the education and well being of the child and society, biological education must have strong practical biases. This is to say, it must be practical process in which the pupil at every stage is an active participant who deals with things, organisms and situations, instead of being merely a passive recipients of instructions as a fundamental rules.

Although many factors influence the nature of learning in students' practical work, the single factor that makes the greatest impact is the teacher (Tamir and Lazarowitz, 1994:111; and Akalewold, 2oo1:34-35).Because practical work teaching is in many ways different from teaching in ordinary classrooms. Thus one would expect various approaches to teaching. There is no doubt that improved effectiveness of learning in practical work can be achieved only through substantial improvement in teacher preparation

4. Time allocation and its effective use are important major factors to consider in planning curricula for practical work in the laboratory. Research indicates that many teachers are ill-prepared. On top of this, teachers work load should be taken into account in the schools time table.

5. The school administration should allocate a certain amount of money in the form of budget based on the lists produced and depending on what the school can afford, for biology laboratories to be practiced, at least for the materials at their control.

6. School facilities-basic biology teaching materials, equipments and laboratory rooms supplied with all necessary services and storage facilities should be provided and facilitated. Laboratory environments should be allocated for all science lessons (biology, chemistry and physics) at these grades levels. The best curriculum is worthless unless it is used effectively by teachers and students because it is believed to be difficult if not impossible to teach in the current form of the sample schools.

As pointed out in the review parts, PW, as part of what constitute the methods of science, it is not only a means but also an end in science education. Therefore, students must have opportunity and freedom to explore and discover, observe and experiment in laboratory and field works planned purposefully. Schools must have laboratory materials, equipments, storage facilities, and water and electricity services. Most science teaching from middle schools throughout higher level is conducted with in a context of special facilities.

Improving the existing implementation of practical work teaching is most important and may be an urgent task of both teacher and school administrations. Through combined effort good collection of biological specimen can be obtained by teachers and students. In general, school administration may also be sought the help and co-operation of individuals government and non–government organizations to overcame financial and material problems of the school laboratory rooms and equipments.

In general the role of the MOE, REB and ZEO and is central if good quality of biology and science education as the whole, is to become a reality for every students at every levels by choosing the most appropriate ways and means. Numerous studies have reported that is not enough to have philosophical commitment to practical work teaching methods, although that is of course important, but a school instructional strategies and educational organizations must support the goal. The researcher thinks by doing so and by giving due attention to the problem, there will be a chance of meeting the goals.

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Appendix A

ADDIS ABABA UNIVERSITY

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM INSTRUCTION

SCHOOL OF GRADUATE

1. QUESTIONNAIRES TO BE FILLED BY STUDENTS

Instruction: The purpose of this questionnaire is to gather students' opinion on Biology teaching-learning biology regarding the status of implementation of practical works included in the eight upper primary school in Bench-Maji Zone of SNNPR. Since the result of this study depends on your genuine response you are requested to answer the questionnaire frankly.

Direction: - Do not write your name

- Encircle your response out of the given choices
- Please, give a brief comment for the questionnaire where your written suggestion is required and you can use Amharic (if you want)
- Respond to all questions

I. General Information

1. Personal data

Name of the school _____

Sex Male ☐ Female ☐ Grade ☐ Section ☐

II. Magnitude of Students use of Practical Work.

2. How often do biology teachers engage you in laboratory activities in learning biology?

a) Always c) Only sometimes

b) In most case d) Not al all

3. These, if you answer for question no '1' is a, b, and c how did you conduct the activities?

a) Doing practical work either in group or individually

b) Observing/watching whenever others carryout

c) Watching whenever the teacher demonstrates

d) No practical activates at all

e) If any (specify) _____

_____

III. Kinds of Practical Activities

4. How often do you use the following activities in your biology classes? For implementing exercises in your textbooks? Give a number to indicate "extent of use" or frequency of use" in the appropriate box for each kind of activities in accordance with the following key:

1 = very often 3 = seldom

2 = quite often 4 = never

I. Listening to the teachers demonstrating, explaining, and summarizing the activities. ☐

II. **Doing practical activities individually** ☐

III. Doing practical activities in group of 3 – 5 members ☐

IV. Doing practical activities in pair ☐

V. Having to write notes reports on the activities ☐

VI. Observing whenever others doing experiments ☐

IV. Beliefs on the Importance of Practical work methods implement.

5. To what extent do you believe that practical work method helped you in gaining biological knowledge effectively?

a) To a very great extent d) I don't like it

b) To a great extent e)I don't believe

c) To a limited extent

V. Attitude and Interest

6. What do you feel when you participate in practical work activities in biology subject?

a) Very interested d) Not interested at all

b) Interested e) In different

c) Less interested f). Need to get help of other

7. To what extent do you enjoy practical work in learning biology?
   a) Very interested c) Indifferent
   b) Interested d) Uninterested
8. What is your opinion to the laboratory work in learning biology?
   a) Very vital b) vital c) Less vital d) I don't know
9. Please give your reason for the any of your answer for question no. 7 briefly _____

VI. Factors Affecting Practical Work Methods

10. What is your opinion of time allowed for practical activity in textbook biology?
    a) Very adequate b) Adequate c) Inadequate
    d) No time regular scheduled for practical activity
    e) If you have any opinion specify _____
11. Do you think that biology laboratory is well equipped for conducting exercises stated in biology textbooks?
    a) To a very great extent b) To a great extent
    c) To a limited extent d Not at all
12. Where do you think that the materials, and equipments obtained for exercises in biology textbooks?
    a) Collected and prepared by teacher
    b) Collected and prepared by students
    c) Locally with no or low cost by both teachers and students
    c) Obtained from organization like MOE
    f) These, if any specify _____
13. What factors do you think affecting practical work method in teaching or exercising practical activities stated in biology textbooks? (rank them from the most ranked (1) to the east factors(9).
    a. Lack of laboratory room
    b. Lack of laboratory materials, equipments, chemicals, etc school facilities such as electricity, water, etc situations are not conducive.
    c. Lack of adequate time
    d. Lack of teachers methodology of teaching

e. Large class size or large number of students

f. Lack of teacher's motivation and interests in practical experiences

g. The activities are not inviting and are beyond students capacity

h. Lack of students' motivation and interests in practical experiences

i. Lack of due consideration by teacher's

j. If any other please specify_____

_____

14. What is your suggestion on how to improve the implementation of practical work in biology teaching ?

_____

_____

Appendix B

ADDIS ABABA UNIVERSITY

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM INSTRUCTION

SCHOOL OF GRADUATE

1. QUESTIONNAIRES TO BE FILLED BY TEACHERS

Instruction: The purpose of this questionnaire is to gather information on teaching-learning biology teachers' opinion regarding the statues of implementation biology practical works included in the eight upper primary school in Bench-Maji Zone of SNNPR. Since the result of this study depends on your genuine response, you are requested to answer the questionnaires frankly.

Direction: - Do not write your name

- Encircle your answer out of the given choices
- Please, give a brief comment for the questionnaire where your written suggestion is required you can use Amharic (if you want)
- Respond to all questions

General Information

1. Personal data

   Name of the school _____

   Sex Male ☐ Female ☐

   Current academic qualification

   a. Diploma b. Certificate c. Any other (specify) _____

2. Year of experience in teaching

   a) biology _____ b) other specify _____

3. Number of periods you teach per week

   a) Biology _____ b) other subjects specify _____

4. Average number of biology students per class in your school that you are teaching

   a) Grade 7 _____ b) Grade 8 _____

A. Existing practice or use of practical work

5. How often do you engage your students impractical activities stated in biology textbooks?

   a) In most case b) to often

   c) Only sometimes d) not at all

6. How often do you practice laboratory work method in teaching biology?

   a) To a very great extent b) To a great extent

   c) To a limited extent d) To a very limited extent

   e) Not at all

B. Kinds of Practical work methods

7. How often do you practice the following approaches in teaching biology? Put a **letter to indicate** the extent of use in the appropriate space given for each kind of activities in accordance with the following key: A = very often a = very often b = Quite often

   c = Seldom d = Not at all

   I. Teacher demonstration while students are observing ☐

   II. Individual student activities ☐

   III. Pair of students practical activities ☐

   IV. Group of 3 – 5 students practical activities ☐

8. To what extent do you believe that practical work method is useful in gaining biological knowledge?

   a) To a very great extent b) To a great extent

   c) To a limited extent d) I don't believe e) I don't like

9. If your answer for question No. 7 is "d" give your reason briefly _____

_____

C. Role of Teacher

10. What do you think the role of the teacher whenever students carryout practical activities stated in biology textbooks?

a) Correcting errors on spot

b) facilitating, encouraging and guiding in practice

c) discussing with them after words

d) If other specify _____

D. Beliefs on the importance of practical work methods

11. What is you opinion of the practical work method in teaching biology?

a) very vital b) vital c) less vital

d) I don't agree with its vitality e) I don't know

E. Attitude and interests

12. What do you feel of engaging students in practical works in the textbooks?

a) Very interested b) Interested

c) Uninterested d) I don't like it at all

e) If any other specify_____

_____....._____

13. How do you enjoy practical work method in teaching biology?

a) very interested b) interested c) indifferent

d) uninterested e) if any other specify _____

14. If your answer for question No. 13 is "d" what initiated you to become biology teacher

a) job opportunity b) by chance

c) Interest in being biology teacher d) If any specify _____

15. If your answer for question No. 13 is "c" or uninterested what do you think is the reason

a) Teaching biology is difficult

b) Teaching biology is practical biased which can not be practiced due to various reasons

c) Planning and preparation for teaching practical work is tiresome

d) If any other "Specify" _____

16. If your answer for question No. 15 is "b" what do you think is the reason? _____

F. Factors Affecting practical work implementation

17. To what extent do you think that biology laboratory is well equipped for the practical activities stated in the textbooks?

a) To a very great extent b) to a great extent

c) To a limited extent d) Not at all

18. Where do you think that the materials and equipments obtained for exercises in biology text books?

a) Collected and prepared by teachers

b) Collected and prepared by students

c) Locally with no or low cost by both teachers and students

d) Collected form organization like MOE

e) If any specify _____

_____

19. Are there sufficient school facilities, equipments, materials, chemicals and other similar resources available for the practical activities stated in biology textbooks?

a) Yes there are b) no there are not

c) Only for few exercises d) not at all

e) If any please specify _____

20. What is your opinion of time allowed for practical activities in biology?

a) Very adequate b) adequate c) inadequate

d) No regularly scheduled time for practical activities

e) If any other opinion specify_____

21. Does your school allocates budget for purchasing of materials necessary for implementing practical works stated in the textbooks?

a) Yes b) No

22. What method do you commonly use to assess your studetnr mastery of practical work?

a) Observation b) written tests

c) Actual practical activities

d) If any other specify_____

23. What factors do you think that inhibit practical work implementation in teaching biology in your school? (Rank them from the most ranked (1) to the least ranked (9).

a) Lack of laboratory room

b) Lack of laboratory equipments, school facilities, materials such as water electricity, etc are not conducive.

c) Lack adequate time

d) Lack of teachers' methodology of teaching

e) Large number of students

f) Lack of teachers' motivation and interest in practical exercise

g) The activities are not inviting and experiments are beyond mental capacity of children

h) Lack of students' motivation and interests towards practical activities

i) Work load and shortage of time for teachers

j) Other specify _____

24. What is your suggestion, on how to improve the use of practical work methods in teaching biology? _____

_____

_____

APPENDIX C

ADDIS ABABA UNIVERSITY

COLLEGE OF EDUCATION

DEPARTMENT OF CURRICULUM INSTRUCTION

SCHOOL OF GRADUATE

3. INTERVIEW QUESTIONS FOR SCHOOL ADMINISTRATORS AND HEAD TEACHERS OF BIOLOGY DEPARTMENT

1. How often do biology teachers use practical activities in teaching biology?
2. Do you think that laboratory work teaching is being practically implemented in biology? Please give your justification for any of your answers:
3. How often do biology teachers engage students in laboratory works?
4. Do you think that the biology lab in your school is well equipped with sufficient and necessary equipments, chemicals, etc for teaching biology? Mention the case of microscope, slides, specimen etc... for instance.
5. Do you undertake inventory activities of the lab for checking the lose, used up etc... yearly?
6. Does your school have annual budget allocated for purchase of materials, equipment and resources necessary for conducting practical activities? Is there a regular schedules period for biology practical activities.
7. What are the major factors that you think would affect practical work method in teaching biology in your school?
8. What is your suggestion on how to improve the implementation of practical work method in biology?

Appendix D

4. Observation Check lists

Availability of Laboratory or Science Room, Laboratory Equipments, Chemicals In Accordance With the Curriculum Demand and Other School facilities .

No	Materials and chemicals	Observed schools						Rmark
		Mizan		Genja		Gacheb		
		Avai lable	Not avail able	Avai lable	Not avail able	Avai lable	Not avail able	
1	Laboratory or Science room	A			NA		NA	
2	Water [illegible]	A			NA	A		Not for lab rooms.
3	Microscope		NA		NA		NA	
4	Glass slides		NA		NA		NA	
5	Slide cover		NA		NA		NA	
6	Hand lens		NA		NA		NA	
7	Insect net		NA		NA		NA	
8	Pond net		NA		NA		NA	
9	Insect pins		NA		NA		NA	
10	Card board or Styrofoam for mounting insects		NA		NA		NA	
11	Petri dish		NA		NA		NA	
12	Forceps		NA		NA		NA	
13	Dropper		NA		NA		NA	
14	Small knife		NA	A		A		in school SPC
15	Samples of traditional and modern beehives		NA	A		A		
16	Test tubes		NA		NA		NA	
17	Thermometer	A			NA		NA	
18	Mirror: concave and complex mirror		NA		NA		NA	
19	Lens – concave and complex lens		NA		NA		NA	
20	Plastic bags		NA		NA		NA	
21	Burners		NA		NA		NA	
22	Beaker		NA		NA		NA	
23	Stand and wire gauze				NA		NA	
24	Measuring cylinder		NA		NA		NA	
25	String or forceps		NA		NA		NA	

26	Charts of different organs of plant and animals, small organisms.	A		A		A		SPC
27	Models, of different organs of plants and animals such as lung, heart etc.	A			NA		NA	.
28	Specimens of different organs or plants and animals, micro- organism-protozoa.		NA		NA		NA	
29	Prepared slides		NA		NA		NA	
30	Iodine solution	A		A			NA	SPC
31	Chloroform solution		NA		NA		NA	
32	Formaldehyde		NA		NA		NA	
33	Glucose		NA		NA		NA	
34	Starch powder		NA		NA		NA	
35	Benedicts solution or feelings solution		NA		NA		NA	
36	Millions of reagent		NA		NA		NA	
37	Oil paper		NA		NA		NA	
38	Plant grown in pot – fern, lichens, etc.		NA		NA		NA	
39	Other relevant reference materials		NA		NA		NA	
40	Quadrate		NA		NA		NA	
41	Terrarium		NA		NA		NA	
42	Records of practical activities performed (if any)		NA		NA		NA	
43	Sisors	A			NA		NA	in SPC
44	Dark paper		NA		NA		NA	
45	Paper dips		NA		NA		NA	
46	Salt		NA		NA		NA	
47	Sugar		NA		NA		NA	
48	Ethanol (alcohol) dine solution		NA		NA		NA	
49	Forceps		NA		NA		NA	
50	Electricity	A			NA	A		Not for lab purpose

Key = A for available
= NV for not available

አዲስ አበባ ዩኒቨርሲቲ ሥነ - ትምህርት ኮሌጅ

የሥርዓተ - ትምህርት መምህራን ሙያ ልማት ትም/ክፍል ድህረ-ምረቃ

ት/ቤት

የተማሪ መጠይቅ

I. አጠቃላይ መመሪያ

የዚህ መጠይቅ ዋና ዓላማ በባዩሎጂ ትምህርት የተግባር ወይም የላቦራቶሪ የማስተማሪያ ዘዴ አተገባበር ደረጃ በተመለከተ መረጃ ለማግኘትና የመፍትሔ ሀሳብ ለመሻት ጥናት ለማካሄድ ይህ መጠይቅ በመሰብሰብ ላይ ይገኛል።

ለጥናቱ ውጤታማነት ያንተ/ያንቺ/ ቀናና እውነተኛ ምላሽ ወሳኝ በመሆኑ ጥያቄዎቹን በጥንቃቄ በማንበብና በትክክል በመረዳት እንድትመልስ/ሽ እጠይቃለሁ።

- ስም መጻፍ አያስፈልግም
- ለቀረቡት ጥያቄዎች ከተሰጡት አማራጮች የትክክለኛውን መልስ ፊደል በማክበብ መልስ/መልሽ። ከቀረቡት አማራጮች ከአንድ በላይ መልስ ካጋጠመህ ከከፍተኛው ጀምሮ 1ኛ ፣ 2ኛ ፣ 3ኛ--- ደረጃ በመስጠት መመለስ ይቻላል።
- ያንተን/ያንቺን አስተያየትና ሀሳብ በጹሁፍ ለሚፈልጉ ጥያቄዎች አጭርና ግልጽ መልስ በመስጠት የቀረቡትን ጥያቄዎች በሙሉ እንድትመልስ/ሽ በድጋሚ እጠይቃለሁ።

II. አጠቃላይ መረጃ

1. የግል መረጃ
   የት/ቤቱ ስም_____
   የክፍል ደረጃ 7ኛ ☐ 8ኛ ☐
   ጾታ፡- ወንድ ☐ ሴት ☐

2. በባይሎጂ ትም/ጊዜ መምህራን ትምህርቱን በተግባር ወይም በላብራቶሪ ሙከራ እንድትማሩ ያደርጓችኋል? ይገፋፏችኋል?
   ሀ. ሁልጊዜ ለ/ አልፍ አልፎ ሐ/ በጣም አነስተኛ ጊዜ መ/ አይሰጥም

3. ለጥያቄ ቁጥር "2" መልስ/ሽ/ ሀ፣ ለ ወይም ሐ ከሆነ ተግባራቱን እንዴት ታከናውን/ኝ ነበር ?

ሀ. በግል ወይም በቡድን የተግባር ሥራ
ለ. ሌሎች ሲሰሩ በመመልከትና በመከታተል
ሐ. መምህሩ ሰርቶ ሲያሳይ በመመልከት ብቻ
መ. ሌላ ካለ _____

_____

4. በባይሎጂ ትም/ጊዜ በመማሪያ መጻህፍት ያሉትን የተግባር ሥራዎች ለማከናወን የሚከተሉትን ተግባራት ምን ያክል ትጠቀማለህ/ ትጠቀሚያለሽ? "የአጠቃቀም ደረጃ" ወይም "ድግግሞች መጠን" ለማመልከት ቀጥሎ የቀረቡትን የቁልፍ ቁጥሮች በመጠቀም ከተግባራቱ ፊት ለፊት በተሰጡት ክፍት ሳጥን ውስጥ ቁጥሮቹን በመጻፍ አመልክት/ቺ።

1. በጣም ብዙ ጊዜ 2. ብዙ ጊዜ
3. አልፍ አልፎ 4. በፍጹም

i. መምህሩ ሰርቶ ሲያሳይ ፣ ሲገልጽና ማጠቃለያ ሲሰጥ ወዘተ መመልከትና ማዳማጥ ☐
ii. በግል የተግባር ወይም ሙከራዎችን በመስራት ☐
iii. ከ3-5 ተማሪዎች በመሆን በቡድን ይሔግባር ስራ ማከናወን ☐
iv. በጥንድ የተግባር ስራ ማከናወን ☐
v. የተግባር / የሙከራ ስራዎችን ውጤት ማስታወሻ መያዝና ሪፖርት በጹሁፍ ማዘጋጀት ☐
vi. ሌሎች ሲሰሩ መመልከት ☐

5. የላብራቶሪ ሙከራ የማስተማሪያ ዘዴ የባዩሎጂ እውቀትን በበቂ ለማግኘት ምን ያክል ጠቅሞኛል ብለህ/ሽ ታስባለህ/ሽ ?

ሀ/ በጣም በከፍተኛ ደረጃ ለ/ በከፍተኛ ደረጃ ሐ/ በአነስተኛ ደረጃ
መ/ አልወደውም ሠ/ አላምንም

6. በላብራቶሪ ሙከራ ወይም የተግባር ትም/ጊዜ ምን ይሰማሃል፣ሻል?

ሀ/ በጣም ከፍተኛ ፍለጐት ለ/ በከፍተኛ ፍለጐት ሐ/ ዝቅተኛ ፍላጐት
መ/ ግድ የለኝም ሠ/ በፍጹም አልወደውም ረ/ የሌሎችን ድጋፍ ለማግኘት እፈልጋለሁ

7. በላብራቶሪ ሙከራ ወይም በተግባር ስራ በመማር ምን ያክል ያስደስትሃል?

ሀ/ በጣም በከፍተኛ ደረጃ ለ/ በከፍተኛ ደረጃ
ሐ/ በዝቅተኛ ደረጃ መ/ ግድየለኝም ሠ/ አላምንበትም

8. በባዩሎጂ የተግባር / በላብራቶሪ ሙከራ የመማር ጠቀሜታን በተመለከተ አስተያየትህ/ሽ ምንድን ነው? ሀ/ በጣም ጠቃሚ ለ/ ጠቃሚ
ሐ/ በጥቂቱ ጠቃሚ መ/ አላውቀውም

9. ለ8ኛ ጥያቄ መልስህ ምክንያቱን በአጭሩ ግለጽ/ጭ _____

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10. ለባዩሎጂ የላብራቶሪ ሙከራ ሥራ የተፈቀደ ጊዜን በተመለከተ ያንተ/ያንቺ አስተያየት ምንድን ነው? ሀ/ በጣም በቂ ነው ለ/ በቂ ነው ሐ/ በቂ አይደለም
መ/ የተመደበለት የጊዜ ሰሌዳ የለውም ረ/ ሌላ አስተያት ካለ

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11. በባይሎጂ መጸሐፍ የተካተቱትን የሙከራ / የተግባር ስራዎችን ለማከናወን ቤተ-ሙከራው ወይም ላብራቶሪው የተሟላ ነው ብለህ/ሽ ታስባለህ/ሽ ?
ሀ/ በጣም በከፍተኛ ደረጃ ለ/ በከፍተኛ ደረጃ ሐ/ በዝቅተኛ ደረጃ
መ/ በጣም በዝቅተኛ ደረጃ ሠ/ ምንም የለውም::

12. በላብራቶሪ ሙከራ ጊዜ የምትጠቀሙባቸው ቁሳቁሶችና ኬሚካሎች ከየት የተገኙ ናቸው ብለህ ታስባለህ/ሽ ?
ሀ/ በመምህራን የተሰበሰቡና የተዘጋጀ ለ/ በተማሪዎች የተሰበሰቡና የተዘጋጁ
ሐ/ ከአካባቢው ያለወጪ ወይም በቀላል ወጪ የተሰበሰቡና የተዘጋጁ
መ/ ከተለያዩ ድርጅቶች ለምሳሌ ትም/ሚ/ር የተገኙ ሠ/ ሌላ ካለ_____

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13. በባይሎጂ መጽሐፋችሁ የሚገኙትን የተግባር / የሙከራ ስራዎች እንዳይተገበር እንቅፋት የሆነው ወይም ያገደው ምንድ ነው ብለህ/ሽ ታስባለህ/ሽ ? / መልስህን ከከፍተኛው ምክንያት ጀምሮ 1.2.3.---9 ደረጃ በመስጠት መልስ/ሽ /
ሀ/ የቤተ-ሙከራ አለመኖር

ለ/ የቤተ-ሙከራ ቁሳቁሶች ኬሚካሎች ፣ ውሃ መብራት--- ወዘተ አለመኖርና የት/ቤት ሁኔታ ምቹ አለመሆን

ሐ/ ለተግባር ስራዎች በቂ ጊዜ አለመኖር

መ/ በክፍል የተማሪዎች ብዛት ከፍተኛ መሆን

ሠ/ ለተግባር ስራዎች የመምህራን ፍላጐትና ዝንባሌ አለመኖር

ረ/ የመምህራን የማስተማር ዘዴና የትም/አቀራረብ አለመኖር

ሰ/ ለሙከራ ስራዎች መምህራን ተገቢ ትኩረት አለመስጠት/ አለመኖር

ሸ/ በመጽሐፍቱ የተካተቱ የተግባር ስራዎች ማራኪ ያለመሆንና ከተማረው አቅም በላይ መሆናቸው

ቀ/ የተማሪዎች ለተግባር ስራዎች ፍላጐትና ዝንባሌ አለመኖር
በ/ ሌላ ካለ _____

14. በቀጣይ በባዩሎጂ ትምህርት የሙከራ ወይም የተግባር ስራዎችን አተገባበር ለማሻሻልና ለማጠናከር አስተያትህን በአጭሩ ግለጽ::

DECLARATION

I the undersigned, declare that this thesis is my original work and has not been presented for a degree in any university. Moreover, I declare sources or materials used for the thesis have been duly acknowledged.

Name Olani Sutuma

Signature _____

Date 14, July 2008

Supervisor / Advisor

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